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MAY 1957

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(See page 38)

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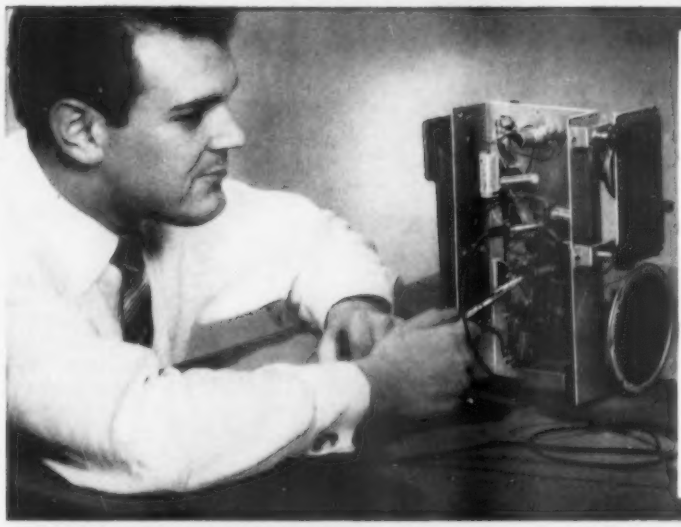

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MAY, 1957

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**ON THE COVER**

Typical hi-fi enthusiast Carol Hughes of New York City prepares to install the speaker in a Cabinart pre-finished enclosure kit.

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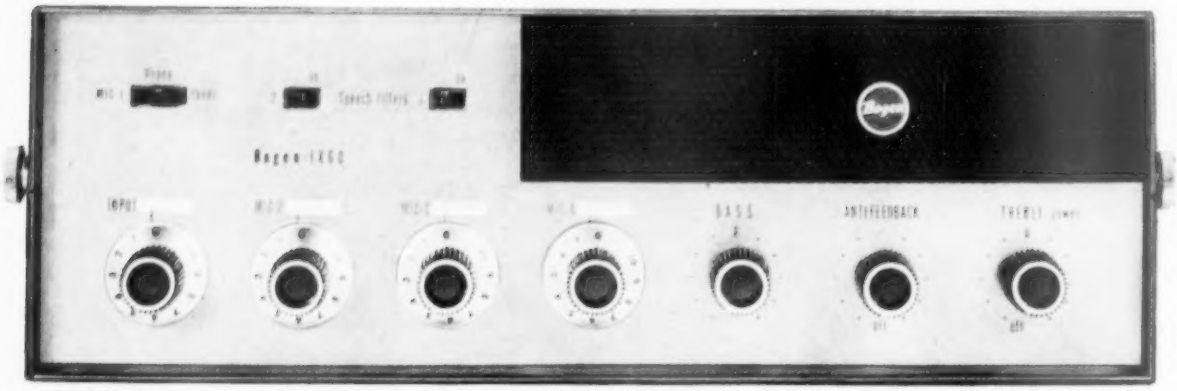


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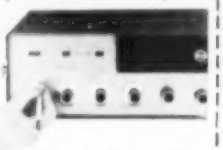

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EDWARD HAHN, Illinois. Now an electronics technician with Televiso, Inc. DeVry Tech training helped him prepare for his present position.

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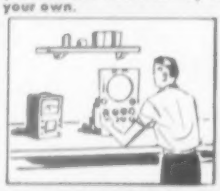

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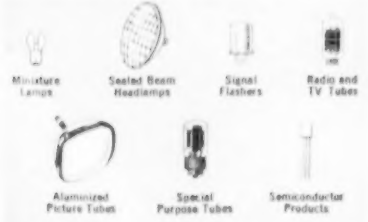


# News Briefs

**TACAN DATA LINK,** latest contribution to air safety, may be a major step to an air-traffic control system able to handle not only present high-speed aircraft but also the coming traffic problems of the jet age.

Tacan and its commercial counterpart Vortac give the pilot accurate information on his bearing and distance from the station, but do not solve the problems faced by the ground controller at a busy airport. He should know the exact position of a large number of planes—as well as their altitude, speed and heading—at the same time, and be able to give directions to them almost simultaneously.

Added to the Vortac or Tacan system, the Data Link originates information which rides "piggyback" on the Tacan transmission. Henri G. Busignies, president of Federal Communications Laboratories, in a recent introduction of the equipment, explained that these transmissions can supply full data on identification, speed, course, altitude and position every 6 seconds. The ground station can issue instructions covering all these by simply pressing buttons which cause the orders to appear on the face of the corresponding meters in the aircraft. In addition, a "library" of 31 messages can be transmitted and, due to the nature of the equipment, they will appear in each plane in the language of the pilot.

The Data Link can easily supplement present Vortac or Tacan systems by adding a few pieces of equipment and installing meters modified to show orders and include pickups for information to be transmitted.

The Tacan Data Link airborne equipment provides a system that permits the ground controller to indicate on the instruments in the plane what speed, height, rate of descent and direction to fly.

**RADIATION INTERFERENCE** by TV receivers above 260 mc will now have to meet FCC requirements on all uhf TV chassis placed in production by June 30, 1957, and all TV receivers manufactured after Dec. 31, 1957. This represents a 6-month postponement over the original dates the FCC set for compliance with regulations limiting the radiation of TV receivers. After the new dates, all receivers will require certification that their radiation does not exceed the legal limits.

Postponement was requested by Radio-Electronics-Television Manufacturers Association.

**TRANS-ATLANTIC SCATTER** plan of an ionospheric scatter system for fixed trans-Atlantic communications was adopted in Montreal, Canada.

The Council of the International Civil Aviation Organization approved a proposal by the United States to form a forward propagation system between Canada, Iceland, Greenland, Ireland and England. (See "Over-the-Horizon Radio Presages World Television," RADIO-ELECTRONICS, September, 1956.)

This system will be similar to that between Alaska and the Aleutians where point-to-point communications have been established with Collins transmitters.

What type of equipment will be used for the North Atlantic system has not been decided. The new system is to be built at an estimated cost of $5 million

(*Continued on page* 12)

**Tacan Data Link airborne equipment display. Meters indicate actual and ordered conditions—latter by second set of numbers or wedge-shaped indicator at dial edge. Right meter is mode (type of ground control) and message indicator. Lower instruments are channel and (air-to-ground) message selector.**

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**TEST ENGINEER**

"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying for my this position." — Boyd Dougherty, Falls Church, Va.

**AIRLINES**

In a year and a half, he received his first class FCC License. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience. — Bob Thompson, Nashville 14, Tennessee

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS WITH OUR COACHING

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|---|---|---|
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| Prentice Harrison, Lewes, Delaware | 1st | 27 weeks |
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| W. E. Evey, Ottawa, Kansas | 2nd | 24 weeks |
| Raymond L. Gersig, Pittsburgh, Pa. | 2nd | 24 weeks |

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★ "Magic-Eye" Indicator
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**$12.50**

A tremendous aid to speedier, more profitable servicing—and you save almost 60% over comparable factory-wired units. Permits testing of capacitors while they are wired in the circuits! Simply press a button and the "magic eye" shows opens and shorts (not leakage). Checks by-pass, blocking, coupling and filter capacitors. Tests for opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts can be made on any capacitor up to 2000 mfd, even when shunted by as low as 20 ohms. 7¾ x 5¼ x 5". With tubes, wire, solder. Shpg. wt., 5 lbs.

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NEWS BRIEFS *(Continued from p. 8)*

and, when completed, all stations would be operated by civilians.

**TECHNICAL WRITING** is the big problem of the electronics industry, according to John L. Kent, editorial bureau chief for Consolidated Electrodynamics Corp. The problem area includes technical reports, manuals, news releases and house publications, he said.

Mr. Kent feels that colleges and industry are responsible for any shortage of technical writers. He said, "Very few education institutions make an effort to furnish the writing training needed as the basis for good technical writing."

In speaking of industry Mr. Kent blames some of the poor technical writing on administrative policies by stating, "Many firms hire a technical writer without giving much thought as to how and what they want him to write. Style books are almost nonexistent and each firm's way of writing is usually carried around in the head of its technical writing chief."

**TWO NEW TV STATIONS** were this month added to our TV station list:

KTWO-TV, Casper Wyo. ..... 2
KBAS-TV, Ephrata, Wash. ..... 43

Two stations, however, have suspended their telecasting activity:

WTVE, Elmira, N.Y. ..... 25
WBLN, Bloomington, Ill. ..... 15

There were a number of changes in call letters:

KEDY-TV, Big Spring, Tex. ..... 4 (formerly KBST-TV)
KGUN-TV, Tucson, Ariz. ..... 9 (KDWI-TV)
WCDC, Adams, Mass. ..... 19 (WMGT)
KPLO-TV, Reliance, S. D. ..... 6 (KPLO)

In the United States and its territories, there remains a total of 497 operating stations (402 vhf and 95 uhf), of which 23 are noncommercial (6 uhf).

Canada now has 14 stations, having started 2 more:

CFSN-TV, Stephenville, Nfld. ..... 8
CJIC-TV, Sault Ste. Marie, Ont. ..... 2

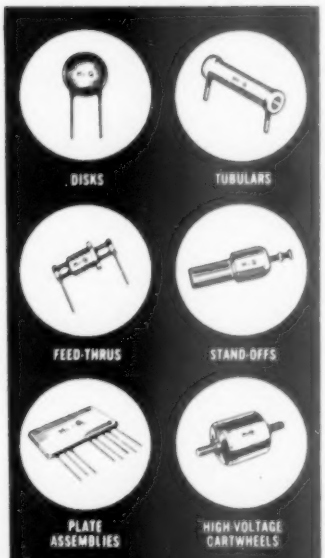
**A NEW SEMICONDUCTOR** may be the fundamental chlorophyll material by which sun energy is stored in the green plant.

Drs. William Arnold and Helen K. Sherwood of the Oak Ridge National Laboratory's biology division suggest that chloroplasts (bits of chlorophyll washed out of tobacco, spinach, beet and turnip leaves) act like semiconductors.

"If it is established that chloroplasts are semiconductors," they say, "then our ideas on the first step in photosynthesis may need some revision."

Two similarities are: dried chloroplasts and suspensions of Chlorella algae glow like inorganic crystals when light shines on them and, when heated,

*(Continued on page 16)*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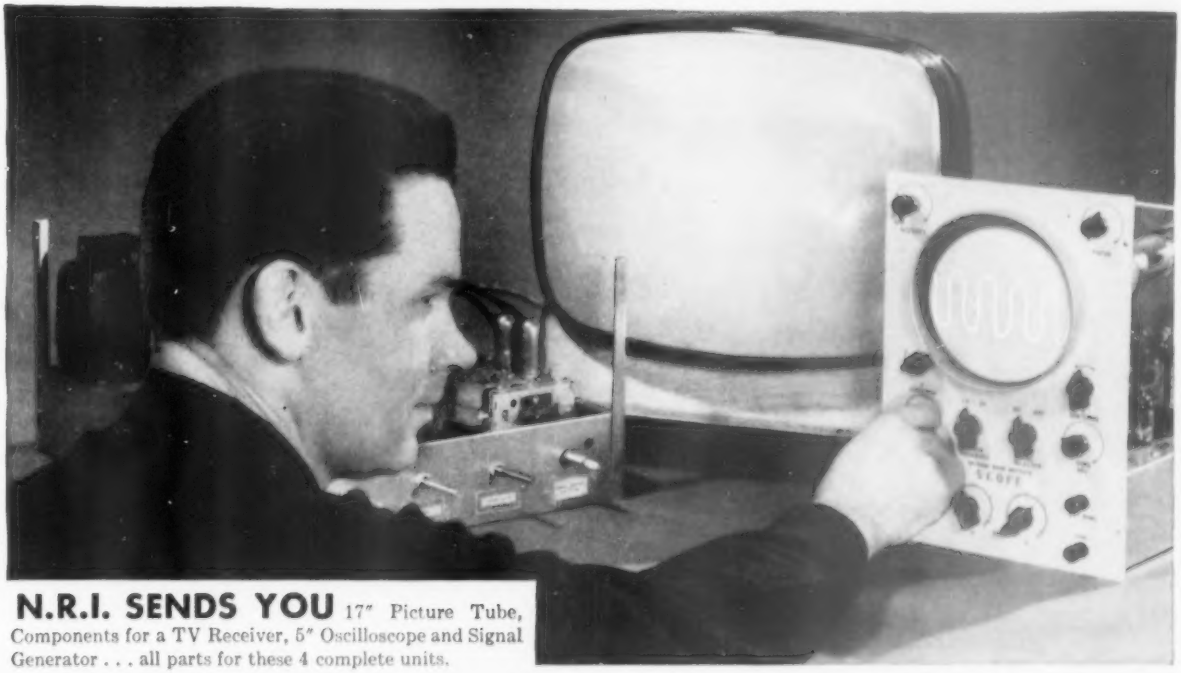
# Learn to be a PROFESSIONAL TV Technician AT HOME



**N.R.I. SENDS YOU** 17" Picture Tube, Components for a TV Receiver, 5" Oscilloscope and Signal Generator . . . all parts for these 4 complete units.

## N.R.I. All-Practice Method Trains You in Spare Time to Fix TV Sets Quickly, Correctly, with Confidence

How many times have you day-dreamed of being your own boss? Or thought about what you could do if you were the man who made the decisions. The man who knows the answers—the well trained Technician—enjoys the prestige, gets the better jobs, higher pay. It's time to stop dreaming. Here is the learn-by-practice training that shows you the way to be the boss, to earn top pay. Television Servicing needs well trained men.

Yes, if you have a basic knowledge of radio and electronics you can make some Television repairs some of the time. You can make some simply by trial and error. But sooner or later you will face Television Service problems you cannot solve. All the diagrams in the world won't help you then. And you can't get the training you need while customers wait.

### NRI Is Oldest and Largest Home Study Radio-TV School

Forty years' experience, and the record and reputation of NRI, back up this learn-by-doing Professional TV Servicing course. Instead of reading about TV problems, you build and conduct experiments on circuits in a TV receiver. Because you learn methods, "tricks of the trade" used and proved by top TV Servicemen, you recognize and repair defects quickly and accurately. Learn to fix any set . . . any make, any model . . . with confidence. Earn a Diploma that certifies to your training.

### Television is Forging Ahead with More Sets, More Color, Hi-Fi

TV Servicing has only started to grow in importance. New sets, portables, color TV, constant changes, improvements make this a genuine "gold rush" for the man who is trained and ready. Know . . . so you can get ahead. Learning how to build and use a professional-type 5" Oscilloscope is part of the practice you get in this NRI All-Practice Training. Installing front-end channel selector strips, distinguishing between a faulty blocking oscillator or a defect in the sync circuit, etc. are just a few of the important TV Servicing facts you learn through practice.

### NOT FOR BEGINNERS

Here is a course for men who know basic theory, either from Radio or TV Servicing experience or planned training, but realize the need for more knowledge to be able to forge ahead. Get details of this course now. Mail coupon today. Address: National Radio Institute, Dept. 7EFT, Washington 9, D. C.

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Please send FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

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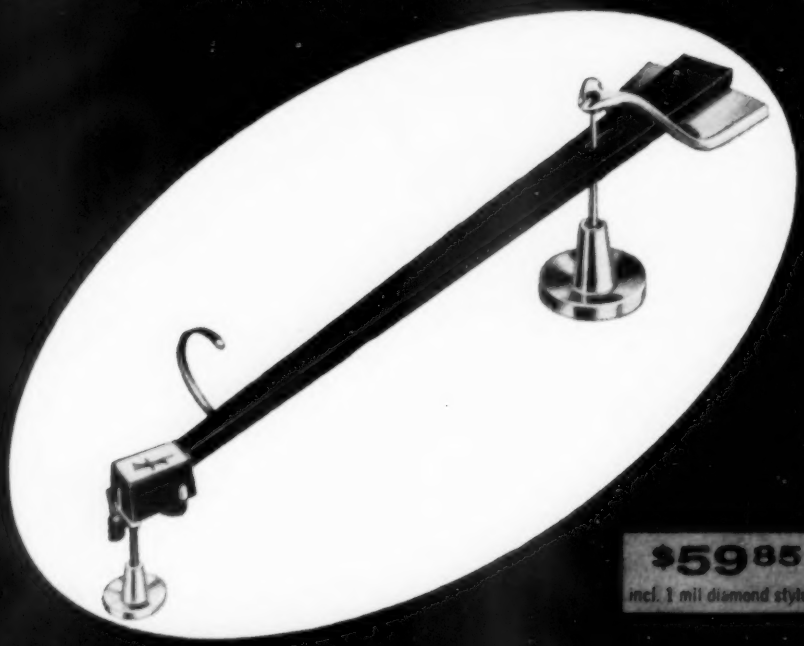

**$59.85**
incl. 1 mil diamond stylus!

# Fluxvalve-Unipoise pickup-arm

WITH ITS OWN BUILT-IN CARTRIDGE CONTAINING AN EASILY REPLACEABLE STYLUS...ALL STYLUS SIZES ARE AVAILABLE INCLUDING THE EXCLUSIVE ½ MIL

**The all-knowing, the cognoscenti, music critics and record-playing enthusiasts have accorded the Fluxvalve-Unipoise Arm an acceptance never before seen in the history of Hi-Fi equipment. Here is the ultimate arm-cartridge for perfect tracking . . . for minimum stylus wear . . . for maximum record life and for optimum performance . . . there's nothing like it . . . nothing to compare.**

**The Fluxvalve-Unipoise Arm, latest development in record-playing arm-cartridge combinations, embodies all the features exclusive to the Fluxvalve . . . and at the remarkably low price of $59.85 for the arm-cartridge combination—including 1 mil diamond stylus!**

*This combination of features is exclusive with the Fluxvalve-Unipoise:*

- Very high compliance
- Very low tracking force, 2-4 grams
- Resonance-free, flat frequency response to 30kc
- Distortion-free dynamic tracking
- All stylus sizes, **including ½ mil**
- Maximum stylus life
- Minimum record wear
- Feather-weight, airframe design
- Single friction-free pivot bearing
- High output
- Easily replaceable styli

*Ultra-dynamic styling to match ultra-dynamic performance!*

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Enjoy a demonstration at your hi-fi sound studio . . . you'll hear the difference. For the dealer nearest you or for literature write Dept. P-16

# You Have More TO SELL WITH A *Winegard*

The more sound selling facts you can put before a customer, the more chance you have of closing a sale! And the Winegard Color'Ceptor gives you selling points no other antenna can offer . . . exclusive buying appeals that clinch 9 out of 10 sales!

### They See the Gold and They're Sold

The gold-anodized finish of the Color'Ceptor gives it a rich, quality appearance not found in any other antenna. When you show the Color'Ceptor alongside competitive models, the Color'Ceptor is so distinctive, so *finished-looking* that it is invariably selected by your customers. Gold-anodizing has a practical sales advantage, too. It provides immunity to corrosion—prevents deterioration in performance.

**If the Winegard Color'Ceptor won't bring in a station you want to see . . . nothing will!** Proof of performance was dramatically illustrated when Robert Seybold of Dunkirk, New York—using a Winegard Antenna—broke all long-distance reception records in 1956 (see Radio-Electronics Magazine Jan. '57). Equipped with optional signal-boosting Power-Pack and patented "Electro-Lens"* focusing, the Color-'Ceptor is second to none for long distance reception and clear, watchable pictures in both black-and-white and color!

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**ANTENNA SPECIALISTS**
Installation • Service • Sales
***Winegard***
**TELEVISION ANTENNAS**

### The Sign of Better Business

The Winegard Authorized Dealer decal (pictured above) is proving a real business-builder for every dealer who displays it. Heavily promoted in Winegard's national advertising, the decal tells the world that "here's the place to buy the gold-anodized Color'Ceptor."

### Want More Details?

Mail coupon below for all the facts on Color'Ceptor's spectacular success story! Winegard gives you everything you need to make antenna sales boom—the product, free display, national advertising, proven sales techniques. Join the swing to Winegard—it's the best move you can make!

**WINEGARD COMPANY**
**Dept. A-5, 3000 Scotten Blvd.**
**Burlington, Iowa**

Name _____

☐ Please rush me free 4-color descriptive literature on your gold-anodized Color'Ceptor and information on display material.

☐ I'm interested in the complete line of new 1957 Winegard antennas.

Company _____

Address _____

City _____ State _____

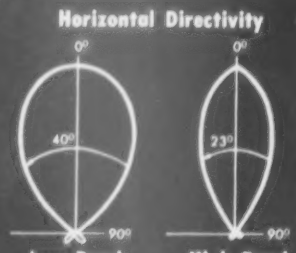
Gold Anodized

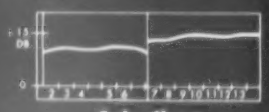
# *Winegard* Color'ceptor TV Antenna

***all 12 VHF Channel Reception For Both Black-and-White and Color***

## Color so bright they sell on sight!

**Note:**
Each gold Color 'Ceptor you install helps sell another. Once folks see these bright gold antennas sprouting up in their neighborhood, they won't be satisfied until they own the gold antenna, too!




**Gain Chart CL-4X with Power-Pack**

**Color'Ceptor Model CL-4X — $44.90**

**Color'Ceptor Model CL-4 — $29.95**

If Color 'Ceptor won't bring in a station you want to see . . . nothing will!

**Exclusive Color'Ceptor features**

- Completely non-corrosive gold-anodized finish.
- Power-Pack—up to 47.1% more sensitivity.
- Pat. "Electro-Lens"* - clearer pictures at greater distance.

Winegard Color 'Ceptors are consistently advertised in leading national magazines your customers read!

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*Pat. No. 2,700,105 Copyright USA, 1957

**Specifications**

**Description:** The 121-C is a self-powered equalizer and preamplifier, complete with the dynamic noise suppressor. **Input Facilities:** 2 magnetic inputs, switched on front panel; crystal or ceramic input; five high-level channels including provision for tuner, tape and TV sound. **Tape Recording and Monitoring:** Two special tape recorder output connections, plus monitor channel with monitor-playback switch. **Tape Playback:** Separate channel, with NARTB tape equalization, for playback of tape direct from tape heads. **Frequency Response:** Flat from 19 cps to 35 kc. **Total hum and noise:** On high level inputs 85 db below full output; on low level inputs, 3.2 microvolts equivalent noise input. **Dimensions in mahogany case:** 13½" x 5" x 9½" $159.95 — Mahogany Case $19.95.

**THE 121-C**
**Dynaural Equalizer Preamplifier**
The most versatile control and compensation unit ever offered. It includes continually variable record equalizers and Scott's patented Dynamic Noise Suppressor.

# H. H. Scott presents Components for the Perfectionist

h. h. Scott

H. H. Scott, Inc., 385 Putnam Ave
Cambridge, Mass.

• The Most Versatile Control and Compensation Unit Ever Offered — The 121-C Dynaural Preamplifier.

• The Cleanest Sounding Power Amplifier Ever Developed — The "280" 80 Watt Power Amplifier.

**The "280" 80 Watt Laboratory Power Amplifier**
The 80-watt output of this superb amplifier provides ample power reserve for the most demanding applications. Its exclusive Dynamic Power Monitor affords full output on music, yet automatically protects expensive speakers against burnout.

**Specifications**

**Power ratings:** 80 watts on music wave-forms (short-time maximum r.m.s.); long-time continuous output 65 watts r.m.s. instantaneous peak output 160 watts. Frequency response: Flat from 12 cps to 80 kc. **Dynamic Power Monitor:** Reduces possibility of speaker burnout on overload by limiting maximum continuous output to any value desired between full power and 10 watts. **Speaker Damping control:** Permits continuous adjustment of output impedance to any value between 3% and 200% of load impedance. **Total Hum and Noise:** 90 db below full output. **Harmonic Distortion:** Less than 0.5%. **First-order difference tone IM distortion:** Less than 0.1%. **Outputs:** 3 to 24 ohms and 70 volt tap. $199.95.
**Also from H. H. Scott:** The "240" 40 Watt Laboratory Power Amplifier incorporating many of the features of the "280" ... only $99.95

Complete H. H. Scott Amplifiers Start at $99.95!

**WRITE FOR YOUR FREE COPY OF H. H. SCOTT'S NEW CATALOG**
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Rush me your new catalog E-5, showing complete high fidelity systems for my home.

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Export Dept: Telesco International Corp.
36 W. 40th St., New York City

NEWS BRIEFS *(Continued from page 12)*

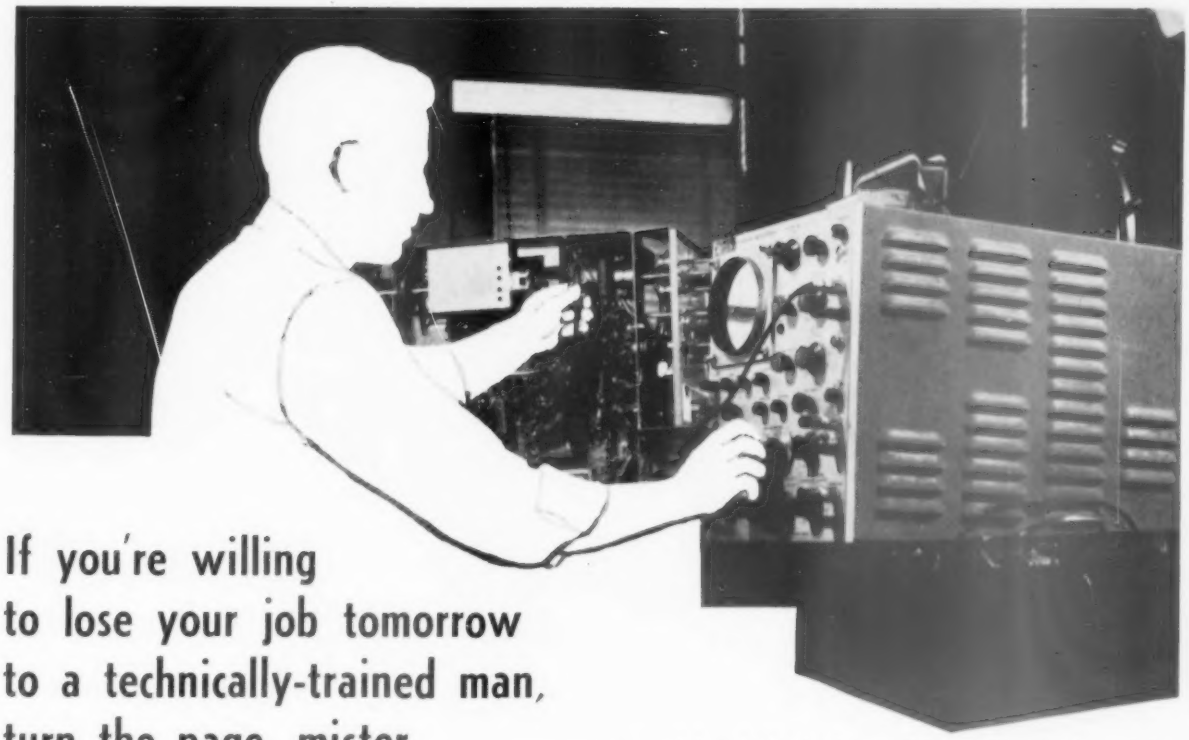
their electrical resistance shows changes that might be due to freeing of electrons, as semiconductors.

**UHF, VHF DEINTERMIXTURE** in 12 areas by order of the FCC is intended to eliminate direct competition between uhf and vhf television stations. Of the areas involved 10 were made all uhf and 2 will remain vhf. However if some affected station decides to take the decision to court, it might be two or three years before some changes would take effect.

## Calendar of Events

**81st Convention of Society of Motion Picture & Television Engineers,** April 28–May 3, Shoreham Hotel, Washington, D.C.
**1957 Electronic Components Symposium,** May 1–3, Morrison Hotel, Chicago.
**Northeastern District Meeting of AIEE,** May 1–3, Wendell-Sherwood Hotel, Pittsfield, Mass.
**Fourth Annual Conference for Engineers & Architects,** May 3, Ohio State University, Columbus, Ohio.
**Instruments, Electronics & Automation Exhibition,** May 7–17, Olympia, London, England.
**Pacific Northwest Instrumentation & Automation Exhibit,** May 9–10, Seattle, Wash.
**Microwave Ferrites and Related Devices and Their Applications Symposium,** May 9–10, Western Union Auditorium, New York.
**National Aeronautical & Navigational Electronics Conference,** May 13–15, Dayton, Ohio.
**2nd Annual Industrial Nuclear Technology Conference,** May 14–16, Museum of Science and Industry, Chicago.
**10th Annual Conference of Industrial Communications Association,** May 15–17, Hotel Dennis, Atlantic City, N. J.
**Armed Forces Communications & Electronics Association Meeting,** May 20–22, Sheraton Park Hotel, Washington, D. C.
**Scottish Radio Show,** May 22–June 1, Kelvin Hall, Glasgow, Scotland.
**1957 Electronic Parts Distributors Show,** May 20–23, Conrad Hilton Hotel, Chicago. (RADIO-ELECTRONICS AND GERNSBACK LIBRARY will exhibit in Room 501.) Closed show for manufacturers, representatives and distributors. Admission by badge only.
**33rd Annual Session of Communications Section of Association of American Railroads,** May 21–23, Hotel Royal York, Toronto, Canada.
**National Telemetering Conference,** May 27–29, Hotel Cortez, El Paso, Tex.
**1st Annual Conference on Production Techniques,** June 6–7, Willard Hotel, Washington, D. C.
**National Technical Career Conference and Exposition,** June 8–12, Sherman Hotel, Chicago.
**2nd RETMA Symposium on Applied Reliability,** June 10–11, Hotel Syracuse, Syracuse, New York.
**National Convention on Military Automation,** June 16–20, Sheraton Park Hotel, Washington, D. C.
**British IRE Convention,** June 27–July 1, University of Cambridge, England.

**TWO COMPETITIVE STATIONS** joined hands recently to present a binaural program as a demonstration of sterophonic sound. Broadcast radio stations WBBC (1330 kc) and WKMF (1470 kc) of Flint, Mich., cooperated with Bill Lamb, a disk jockey employed by WBBC, in the 55-minute program. Using his own composite studio speech equipment and a binaural tape recorder, it took Lamb about 200 hours to produce the program. Effects which would best point out sterophonic reception were used. A ping-pong game, passing train, rifle shot and ricochet and bowling ball were some of the effects presented. Counterpoint melody by Lennie Herman musically illustrated the binaural effect. END



# If you're willing to lose your job tomorrow to a technically-trained man, turn the page, mister

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics. You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. However, you must have some prior electronic experience, either in military service, professional employment, experimenting, or ham operating. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies *you* for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and *grade* your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly specialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge. Ask an electronics engineer, if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer. Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Development; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations that choose CREI to train their own personnel: United Air Lines, Canadian Broadcasting Corp., Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp. and U. S. Information Agency (Voice of America). Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon below, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics." It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details. It's free.

**Note: CREI also offers Residence School instruction, day or evening, in Washington, D.C. New classes start frequently. If you are eligible for training under the new G.I. Bill of Rights, check coupon for more data.**

**CAPITOL RADIO ENGINEERING INSTITUTE**

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3224 16th St., N.W., Dept. 145-D, Washington 10, D.C.

Please send me your course outline and **FREE** Illustrated Booklet "**Your Future in the New World of Electronics**" describing opportunities and CREI home study courses in Electronic Engineering Technology.

**CHECK FIELD OF GREATEST INTEREST**

- ☐ Electronic Engineering Technology
- ☐ Broadcast—AM, FM, TV Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology

Name _____ Age _____

Street _____

City _____ Zone _____ State _____

CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

To help us answer your request intelligently, please give the following information:

EMPLOYED BY _____

TYPE OF PRESENT WORK _____

SCHOOL BACKGROUND _____

ELECTRONICS EXPERIENCE _____

# CHANGER OR TURNTABLE?

Thorens CBA-83 Audiomatic record player

## You get the best features of both in the Thorens CBA-83

Not a changer, not a conventional turntable, but so easy to use you can play it in the dark!

Place your precious records, by hand as gently as you please, on the 12-inch turntable of the Thorens Audiomatic CBA-83. Press the button—there's one for 7, 10, or 12-inch records. That's all you do!

A precision mechanism takes over and lowers the stylus gently and silently into the lead groove. No cueing light required. No stooping to look for the stylus point. No sighting along a cueing mark. No danger of scraping over the first few grooves. You don't need a steady hand—your hand need never touch the tone-arm at all!

Easy playing is just one feature of the Thorens Audiomatic. Take the motor, for example. Like all Thorens units, the Audiomatic is powered by a famous Swiss-precision direct-drive motor to assure silent operation. Accurately machined, electronically-balanced fast-rotating parts hold wow, flutter to less than ½%.

Ask for the Thorens CBA-83 Audiomatic record player at your hi-fi dealer's today! Its performance will surprise you.

And don't forget to send for free booklet "Hi-Fi and Your Budget." Write Thorens Company, Dept. E57, New Hyde Park, N.Y. 7.8

**CB-33 manual player** (above) starts when tone arm is lifted, shuts off silently, automatically at end of record. Has same Swiss-precision motor as CBA-83. From changer to transcription turntable, there's a Thorens for every need.

THORENS ★ FULL YEAR GUARANTEE ★ SWISS MADE PRODUCTS

ONE YEAR GUARANTEE. Now all Thorens units are covered by a 1-year guarantee—4 times as long as the usual 90-day electronic equipment guarantees! Ask your hi-fi dealer about this.

**THORENS**

SWISS MADE PRODUCTS
HI-FI COMPONENTS • LIGHTERS
SPRING-POWERED SHAVERS
MUSIC BOXES
NEW HYDE PARK, NEW YORK


# Correspondence

### LOUDSPEAKERS AND ACOUSTICS FUNDAMENTALS

*Dear Editor:*

Much air must be moved to radiate appreciable power at low frequencies. The following table shows the excursion necessary to produce one acoustic watt output and the acoustic power output capability of a 10-inch piston (equivalent to a 12-inch speaker) executing an excursion of .06 inch (peak amplitude of .03 inch) which is regarded as about the maximum limit for tolerable distortion.[1]

| Frequency | Excursion Needed To Radiate 1 Acoustic Watt | Power Radiated At .06-Inch Excursion Acoustic Watt |
|---|---|---|
| 60 | 0.7 | .0072 |
| 50 | 1.0 | .0036 |
| 40 | 1.5 | .0016 |
| 35 | 2.0 | .00085 |
| 30 | 2.8 | .00045 |

These figures are independent of box shape, suspension compliance or amplifier power supplied.

*The facts of life in acoustics are simply that the undistorted output of a small cone at low frequencies would be too small to hear, regardless of the "response curve".*

In 1931 E. W. Keller proposed the use of 54 cones of 8-inch diameter to radiate 1 watt at 30 cycles, and the use of a corner horn. Structural designs have improved in the following 25 years but acoustical fundamentals have not changed.

There have been little speakers with big claims since the Edison phonograph of 1901, but nobody has devised a miniature 32-foot wavelength.

PAUL W. KLIPSCH
*Klipsch & Associates*
*Hope, Ark.*

### MORE SYMBOLISM

*Dear Editor:*

Mr. Sutton's letter in your December issue was read with much applause, especially since I have always used the arrow to indicate the direction of possible current flow, and sometimes I have even corrected the symbol on the diode itself.

It is no discredit to Benjamin Franklin's greatness that he made a mistake; everyone does occasionally. But why must we be stuck with it forever? One might wonder where science would be today if diehards had been able to prevent the correction of other fallacious theories and people wouldn't ac-

[1] Frank Massa, *Acoustic Design Charts*, Blakiston Co., Philadelphia.

(*Continued on page* 24)

**SPECIAL!** *FOR THE TV-RADIO SERVICE TECHNICIAN*

**NOW!** have the complete

# PHOTOFACT

## Service Data Library

*for as little as . . .*

**$10 DOWN**

UP TO 24 MONTHS TO PAY—
NO INTEREST—NO CARRYING CHARGES

NOW—for as little as $10 down, you can have at your fingertips the *complete* PHOTOFACT Service Data Library and a sturdy four-drawer steel cabinet for easy-reference filing. It's the *only* Service Data Library covering over 28,000 TV, Radio, Record Changer, Recorder and Amplifier models . . . the *only* library that gives you *all* the information you need to repair *more* jobs per day . . . Faster—Better—Easier—and pays for itself as it earns for you!

the world's
**BEST TV-RADIO SERVICE DATA**

**MAKE YOUR MOVE TO BIGGER PROFITS**

***TODAY!***

Fill out the form you'll find on the back page of this insert, and take it to your regular PHOTOFACT Distributor, or mail with your down payment to:

**HOWARD W. SAMS & CO., INC.**
2201 East 46th Street
Indianapolis 5, Indiana

**START EARNING MORE *NOW* . . . SEE FOLLOWING PAGES FOR FULL DETAILS**

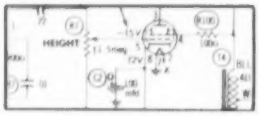
# here's what makes PHOTOFACT the world's best

PHOTOFACT Service Data is the *only verified* service information based upon first-hand examination of the actual production-run receivers and equipment. It is authentic, accurate, uniform data developed through actual study and analysis by expert service engineers in the Howard W. Sams Laboratories. PHOTOFACT is the *only data* prepared from the practical point of view of the Service Technician.

Over 29,000 Service Technicians have standing orders with their suppliers to receive every set of PHOTOFACT Folders as they are published. Thousands of others use PHOTOFACT daily for time-saving, profit-boosting service operations. Over twelve million sets of PHOTOFACT Folders are in use. When you own and use PHOTOFACT, you realize your full earning power in a way you never dreamed possible. And now, Howard W. Sams offers you a great opportunity to own the complete PHOTOFACT Library—your instant service guide to over 28,000 TV, Radio, Recorder, Changer, Amplifier and Tuner models—on a remarkable EASY PAY PLAN—with *no interest* and no *carrying charges!*

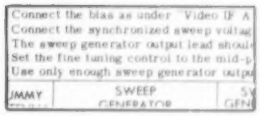
## these great features are exclusive in PHOTOFACT...

### Full Schematic Coverage



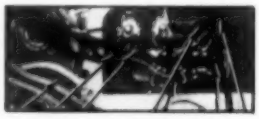

Famous "Standard Notation" uniform symbols (exclusive with PHOTOFACT) are used in every schematic. Diagrams are large, easy to read and handle. Waveforms and voltages are shown right on the schematic for fast analysis. Transformer lead color-coding and winding resistances appear on the schematic. Schematics are keyed to parts lists and to parts on chassis photos.

### Alignment Instructions



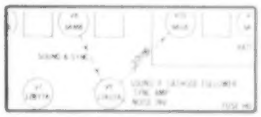

Complete, detailed alignment data is standard and uniformly presented in all PHOTOFACT Folders. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

### Full Photographic Coverage



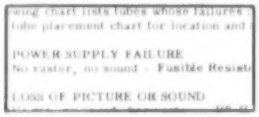
Photos of all chassis views are provided for each model (exclusive with PHOTOFACT), all parts are numbered and keyed to the schematic and to the parts lists for quicker parts identification and location.

### Tube Placement Charts



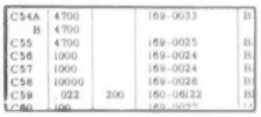
Both top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

### Tube Failure Check Charts




Shows common trouble symptoms and tubes generally responsible for such troubles. Series filament strings are schematically presented for quick reference.

### Complete Parts Lists




Detailed parts list is given for each model. Proper replacement parts are listed (with installation notes where required). All parts are keyed to chassis photos and schematics for quick reference.

**AS LITTLE AS $10 DOWN PUTS THE PHOTOFACT LIBRARY**

# TV-RADIO SERVICE DATA

## AS LITTLE AS $10 DOWN PUTS THE PHOTOFACT LIBRARY IN YOUR SHOP!

Yes, only $10 down now puts the PHOTOFACT Library in your shop! You'll make more repairs daily, you'll earn bigger profits . . . you'll do your work *faster, easier, better* with PHOTOFACT Service Data at your fingertips.

And with our Easy Pay Plan, you'll find that PHOTOFACT actually pays for itself as your earnings grow. Here's the best investment you can make in the future of your service business—so make your move to BIGGER PROFITS *now*—own the PHOTOFACT Library the Easy-Pay-Way!

## TO HELP YOU EARN MORE DAILY

### Field Service Notes

Each PHOTOFACT Folder includes time-saving tips for servicing in the customer's home. Gives valuable hints for quick access to pertinent adjustments, safety glass removal, special advice covering the specific chassis, etc.

### Outstanding General Features

Each and every PHOTOFACT Folder is presented in a standard, uniform layout. You'll always find the information you need quickly and easily. PHOTOFACT gives you complete, up-to-date coverage—TV, Radio, Record Changers, Amplifiers and Tuners. PHOTOFACT maintains an inquiry service bureau for the benefit of its customers.

With the PHOTOFACT Library at your fingertips, you solve your service problems in just minutes—YOU SERVICE MORE SETS AND EARN MORE DAILY! Make the best investment of your business career—put a profit-building PHOTOFACT Library in your shop now!

own the profit-boosting

# PHOTOFACT LIBRARY the EASY-PAY-WAY

use order form on other side

**HERE'S ALL YOU HAVE TO DO:**

1 Check the PHOTOFACT Sets you require to complete your library.

2 Select one of the two convenient filing systems, and enter the quantity of file cabinets or deluxe binders required. (One file cabinet will hold 200 PHOTOFACT Sets. Each binder will hold 10 Sets.)

3 Fill in the value of the binders or file cabinets (if ordered) and total value of the PHOTOFACT Sets.

4 Add the entries in column to find total cost; deduct the proper down payment, to find balance due.

5 Figure your monthly payments ($396 or under, you have up to 18 months—over $396, 24 months to pay the balance) and enter them in the proper spaces and sign your name.

6 Fill in your complete name and address and give this form and your down payment to your regular Sams PHOTOFACT Distributor or mail (along with your distributor's name) to:

**HOWARD W. SAMS & CO., INC.**
2201 East 46th Street
Indianapolis 5, Indiana

That's all you have to do . . . your library will be shipped to you prepaid. (File cabinet, if ordered, is shipped separately collect.)

NO CARRYING CHARGES!
NO INTEREST!

**IN YOUR SHOP NOW!** **ACT TODAY!**

**USE ORDER FORM ON REVERSE SIDE**

MAKE YOUR MOVE TO BIGGER PROFITS WITH THE

# PHOTOFACT TIME PAYMENT PLAN

**FILL OUT THIS FORM—DO IT TODAY!**

I understand I may select and order a library of PHOTOFACT Sets as long as I order a *minimum of fifty* (50). I may also order as a part of this agreement, up to two (2) File Cabinets or as many PHOTOFACT Binders as I may require. I also understand there will be no interest or carrying charges added to this agreement. I agree to the terms as outlined and enclose my down payment.

**ONLY SETS ALREADY PUBLISHED MAY BE ORDERED ON THIS PLAN**

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 31 | | 61 | | 91 | | 121 | | 151 | | 181 | | 211 | | 241 | | 271 | | 301 | | 331 | |
| 2 | | 32 | | 62 | | 92 | | 122 | | 152 | | 182 | | 212 | | 242 | | 272 | | 302 | | 332 | |
| 3 | | 33 | | 63 | | 93 | | 123 | | 153 | | 183 | | 213 | | 243 | | 273 | | 303 | | 333 | |
| 4 | | 34 | | 64 | | 94 | | 124 | | 154 | | 184 | | 214 | | 244 | | 274 | | 304 | | 334 | |
| 5 | | 35 | | 65 | | 95 | | 125 | | 155 | | 185 | | 215 | | 245 | | 275 | | 305 | | 335 | |
| 6 | | 36 | | 66 | | 96 | | 126 | | 156 | | 186 | | 216 | | 246 | | 276 | | 306 | | 336 | |
| 7 | | 37 | | 67 | | 97 | | 127 | | 157 | | 187 | | 217 | | 247 | | 277 | | 307 | | 337 | |
| 8 | | 38 | | 68 | | 98 | | 128 | | 158 | | 188 | | 218 | | 248 | | 278 | | 308 | | 338 | |
| 9 | | 39 | | 69 | | 99 | | 129 | | 159 | | 189 | | 219 | | 249 | | 279 | | 309 | | 339 | |
| 10 | | 40 | | 70 | | 100 | | 130 | | 160 | | 190 | | 220 | | 250 | | 280 | | 310 | | 340 | |
| 11 | | 41 | | 71 | | 101 | | 131 | | 161 | | 191 | | 221 | | 251 | | 281 | | 311 | | 341 | |
| 12 | | 42 | | 72 | | 102 | | 132 | | 162 | | 192 | | 222 | | 252 | | 282 | | 312 | | 342 | |
| 13 | | 43 | | 73 | | 103 | | 133 | | 163 | | 193 | | 223 | | 253 | | 283 | | 313 | | 343 | |
| 14 | | 44 | | 74 | | 104 | | 134 | | 164 | | 194 | | 224 | | 254 | | 284 | | 314 | | 344 | |
| 15 | | 45 | | 75 | | 105 | | 135 | | 165 | | 195 | | 225 | | 255 | | 285 | | 315 | | 345 | |
| 16 | | 46 | | 76 | | 106 | | 136 | | 166 | | 196 | | 226 | | 256 | | 286 | | 316 | | 346 | |
| 17 | | 47 | | 77 | | 107 | | 137 | | 167 | | 197 | | 227 | | 257 | | 287 | | 317 | | 347 | |
| 18 | | 48 | | 78 | | 108 | | 138 | | 168 | | 198 | | 228 | | 258 | | 288 | | 318 | | 348 | |
| 19 | | 49 | | 79 | | 109 | | 139 | | 169 | | 199 | | 229 | | 259 | | 289 | | 319 | | 349 | |
| 20 | | 50 | | 80 | | 110 | | 140 | | 170 | | 200 | | 230 | | 260 | | 290 | | 320 | | 350 | |
| 21 | | 51 | | 81 | | 111 | | 141 | | 171 | | 201 | | 231 | | 261 | | 291 | | 321 | | 351 | |
| 22 | | 52 | | 82 | | 112 | | 142 | | 172 | | 202 | | 232 | | 262 | | 292 | | 322 | | 352 | |
| 23 | | 53 | | 83 | | 113 | | 143 | | 173 | | 203 | | 233 | | 263 | | 293 | | 323 | | 353 | |
| 24 | | 54 | | 84 | | 114 | | 144 | | 174 | | 204 | | 234 | | 264 | | 294 | | 324 | | 354 | |
| 25 | | 55 | | 85 | | 115 | | 145 | | 175 | | 205 | | 235 | | 265 | | 295 | | 325 | | 355 | |
| 26 | | 56 | | 86 | | 116 | | 146 | | 176 | | 206 | | 236 | | 266 | | 296 | | 326 | | | |
| 27 | | 57 | | 87 | | 117 | | 147 | | 177 | | 207 | | 237 | | 267 | | 297 | | 327 | | | |
| 28 | | 58 | | 88 | | 118 | | 148 | | 178 | | 208 | | 238 | | 268 | | 298 | | 328 | | | |
| 29 | | 59 | | 89 | | 119 | | 149 | | 179 | | 209 | | 239 | | 269 | | 299 | | 329 | | | |
| 30 | | 60 | | 90 | | 120 | | 150 | | 180 | | 210 | | 240 | | 270 | | 300 | | 330 | | | |

2

| PHOTOFACT File Cabinets | OR | PHOTOFACT Binders |
|---|---|---|
| $32.95 ea. Net | | $3.50 ea. Net |
| Specify Quantity Here | | Specify Quantity Here |

3

*Value of Cabinets (if ordered) $

Value of Binders (if ordered) $

Value of Sets—$1.95 each $

TOTAL COST $

LESS DOWN PAYMENT $

4

$ 87.50 to $200.00—$10.00 Down

$201.00 to $300.00—$20.00 Down

Over $300.00— $30.00 Down

BALANCE $

State Tax, if any, must be paid along with Down Payment. $

*If File Cabinets are ordered, they will be shipped transportation charges COLLECT from Aurora, Ill.

All other merchandise on this order will be shipped transportation charges PREPAID from Indianapolis, Indiana.

TO REMOVE THIS FORM—TEAR ALONG DOTTED LINE

I agree to pay the balance of $ _____ in _____ monthly payments (if balance is $396.00 or under you have up to 18 months, over $396.00 up to 24 months), _____ payments of ($10.00 **minimum** monthly payments) $ _____, and a final payment of $ _____ due the _____ day of each month. My first payment is due the _____ day of _____, 195 ___

5

Until full payment is made, I agree that title to and right of possession of the merchandise shall remain in you, that I will not sell, remove, or encumber the same without your written consent, that I assume and shall be responsible for all loss or damage to said goods, and that upon default of any payment or payments, you may, at your option, take back the merchandise or affirm the sale and hold me liable for the full unpaid balance.

Your Signature Here—WRITE—do not print X _____ (Purchaser)

NOTE: If you wish, we will gladly figure the payments for you. Just indicate the sets you want, sign your name above and enclose your down payment, we'll do the rest. NO INTEREST—NO CARRYING CHARGES.

6

YOUR DISTRIBUTOR'S NAME AND ADDRESS
(PLEASE PRINT)

Name _____

Address _____

City _____ Zone _____

State _____

YOUR NAME AND ADDRESS
(PLEASE PRINT)

I am a ☐ full time; ☐ part time Service Technician

Name _____

Address _____
(Do Not Use P. O. Box Number)

City _____ Zone _____

State _____

AB

ORDERS ACCEPTED—SUBJECT TO CREDIT APPROVAL

**HOWARD W. SAMS & CO., INC. • 2201 East 46th St. • Indianapolis 5, Indiana**

For Problem-Solving . . . Experimentation . . . Teaching . . . or Just Fun

# BUILD YOUR OWN ELECTRIC BRAIN MACHINE *IN JUST A FEW HOURS!*

**Remarkable 400-Component Construction Kit Enables You to Create Any of 33 Brain Machines! Build LOGIC MACHINES That Compare, Reason, Test Intelligence; ARITHMETICAL MACHINES (Binary & Decimal); GAME-PLAYING MACHINES (Tic-Tac-Toe, Nim, etc.)**

**Teachers and Scientists: *Design Your Own Machines!***

**GENIAC is the only kit and text combination that presents the basic ideas of cybernetics, boolean algebra, symbolic logic and computer circuitry for all levels of knowledge and intelligence. Sold to all customers on a one-week return guarantee; actually use it during that time, return it if you decide not to keep it.**

WITH GENIAC you build any of 33 electric brain machines in a few hours by following the clear-cut, step-by-step directions in the basic text provided. Advanced students and scientists can design machines for special problems. No soldering required, and little wiring. Change design of your machines in minutes! Build Binary Adding Machine • Secret Coder & Decoder • Machine for Arithmetical Carrying • Comparing Machine • Reasoning Machine • General Combination Locks • Games Requiring Logic • Machine for a Space Ship's Airlock • Intelligence Tester • Burglar Alarm • Puzzle Solvers and many others.

### OVER 400 COMPONENTS AND PARTS

Circuits operate on one flashlight battery, and use ingeniously designed parts. 1957 GENIAC Kit has been constructed by the original inventor to provide all the advantages of previous electrical brain construction kits plus what we have learned in answering the questions and examining the new designs created by hundreds of users.

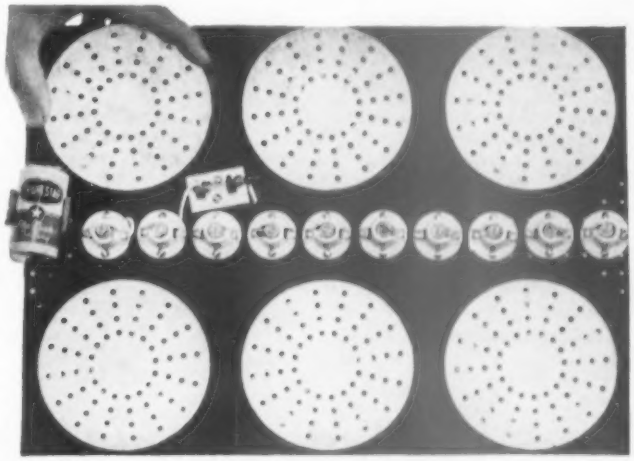
### SELF-CONTAINED COURSE IN COMPUTER DESIGN

Each GENIAC comes as a self-contained course in computer design. All instructions are so simple that we have records of intelligent twelve-year-olds designing factoring machines and puzzle-solving circuits—while hundreds of schools and industrial training programs have incorporated our kits in their curricula.

### YOUR COURSE FOR GENIAC KIT: ONLY $19.95 POSTPAID

The coupon will bring your GENIAC Electric Brain Construction Kit and Manuals for only $19.95 postpaid. You may return the Kit within 7 days if you are not completely satisfied. For schools we offer bulk rates on extra texts and parts; for teachers, we offer 10% deduction on GENIAC if ordered for use in institutions. Send for your Kit today!

**SCIENCE KITS, Dept. RE57B**
**Oliver Garfield Co., 126 Lexington Ave.,**
**New York 16, N. Y.**



1957 GENIAC KIT CONTAINS (1) a complete 200-page text, "Minds and Machines"—a basic introduction to computers. (2) "How to Construct Electrical Brains at Home"—a fully illustrated text book on basic computer design theory and circuits with specific instructions for building 33 circuits. (3) Wiring Diagram Manual. A special booklet with full scale diagrams. (4) Beginners' Manual—fifteen extra experiments to teach the basic symbols of electric circuits. (5) Over 400 components and parts.

**Some Institutions and Firms Now Using GENIAC**

Allis-Chalmers
Remington-Rand
International Business Machines
Wheeldex Mfg. Co.
Manuel Missionary College
Walter V. Clarke Associates
Barnard College
Westinghouse Electric
Phillips Laboratories
General Insurance Co. of America
Lafayette Radio
Rohr Aircraft Co.
Southwest Missouri State College
Albert Einstein Medical College
Naval Research Laboratories
Board of Education, Tecumseh, Nebraska
Marshfield Public Schools
Los Angeles Public Schools
Jefferson Union High School
Oklahoma A & M
Kansas State University
Duke University
Coral Gables Senior High School
Courtland Jr. High School
Bell Telephone Laboratories

**ORDER GENIAC ON OUR MONEY BACK Guarantee!**

**SCIENCE KITS, Dept. RE57B**
**Oliver Garfield Co., 126 Lexington Ave.,**
**New York 16, N. Y.**

Please send me:
1 GENIAC Electric Brain Construction Kit and Manuals.
$19.95 (East of Mississippi) _____
$20.95 (Elsewhere in United States) _____
$21.95 (Outside the United States) _____
Returnable in seven days for full refund if not satisfied. I enclose $_____ in full payment.

Name _____

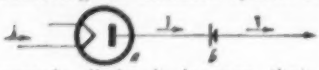
Address _____

City _____ Zone _____ State _____

(Continued from p. 18)

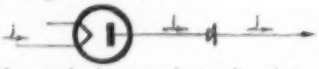
cept the fact that the Earth is round or the theory of relativity, for example, just because they were not the first theories advanced.

Observing the standard symbol for a



thermonic diode, it is seen that the filament symbol forms an arrow pointing toward the plate in the correct direction of current flow. Current flows into the "arrow" and out of the plate lead. Now coming to the symbol for the semiconductor diode, we find that the same plate symbol is used, only now, instead of current flowing out of it, it flows in. We also find that essentially the same cathode symbol is used, only, likewise, instead of current flowing in, it flows out.

So why not simply turn the diode symbol around so that what looks like a plate will actually be a plate and what looks more like a cathode will be one? See diagram below:



No confusion need result, since the arrowhead could be left open or otherwise distinguished from the solid-black arrowhead that would mark an old-style drawing. Thus it would always be apparent which way current is supposed to flow. F. M. ESLICK

*Huntsville, Ala.*

## NEW TYPE OF AMATEUR

*Dear Editor:*

I enjoyed reading your editorial in the February issue. I enjoyed it because I came up through that very route. I got my first "boughten" two-slide tuner from E. I. Co. back in 1911, along with a pair of headphones and a few other small items.

We had a merry time those days, but the International Radiotelegraphic Convention in 1913 put the lid on. I received my first ham license in April, 1914, from J. J. Dillon, Cleveland, Ohio.

I started with the Standard coherer–decoherer, and then silicon, galena and on up the scale until 1915, when I dug up $6 each for a UV-200 and a UV-201. I also bought one of Thomas E. Clark's (TECLA) regenerative receivers. I also switched from the old 1½-inch spark coil to a "spark-tube" transmitter.

In February, 1943, I obtained a 2nd telephone license and joined the ranks of the Radio Engineers.

You mention that the old hobby is lagging. Others scream that the ranks of ham-radio are thinning and there must be new recruits or amateur radio will go down the drain.

And, as you say, communication (CW) is no longer the sole incentive. A great many radio engineers who are full-time employed as commercial operators would—in their spare time—like to experiment toward the bettering of the art and try out some of their ideas.

Of course there are those snobs among the ranks who want to "restrict" ham radio by barring the commercial operator and those desirous of using phone, as well as those whose incentive is experimenting.

There are, as you say, a great many new avenues opening up for the serious experimenter; new ways of modulation, new tubes, transistors, more compact parts, miniaturized tubes, rectifiers, modules and printed wiring.

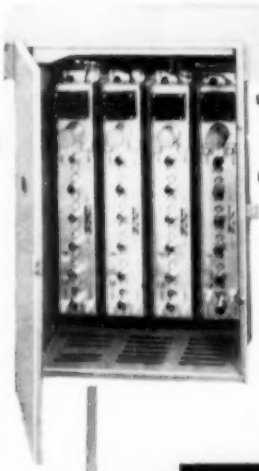
Why confine all this experimentation to "Big Business" factories and corporations? I believe that if the FCC would grant even *one* frequency band to the amateur, *open to all who would conform to the requirements of properly operating their stations as well as the state of the art exists*, without regard to either phone or CW, call it commercial-amateur or a new name, that there would be a stampede to get 'on the air' and try something new, by *both* the neophyte and the commercial operator.

I, for one, would be experimenting with supermodulation and ssb and flea-power within 24 hours. And I wager I could have a dozen recruits to ham radio within a week.

Thanks for the memories, Mr. Gernsback. It is nice to remember that I grew up with radio and that I may have helped in some small way to make it what it is. If I could now follow through into nuclear chemistry I would

*"there must be a reason . . .*

**WHY NEARLY 80% OF ALL CANADIAN COMMUNITY TV SYSTEMS USE *BENCO!*"**



- PRE-AMPLIFIERS
- LINE AMPLIFIERS
- CRYSTAL CONVERTERS
- SOLDERLESS TAP-OFFS, Etc.

**NOW AVAILABLE IN THE U.S.**

For performance, dependability and low maintenance cost Benco equipment is a proven leader—in Canada and the U.S. Technicians appreciate Benco's advanced engineering, easy installation, "built-in" AGC, self contained power supply, precision JAN-type "N" connectors, stainless steel chassis and many more features. Prices are surprisingly attractive.

Benco offers you without obligation—Plans, Specifications, Technical Assistance and Engineering skill.

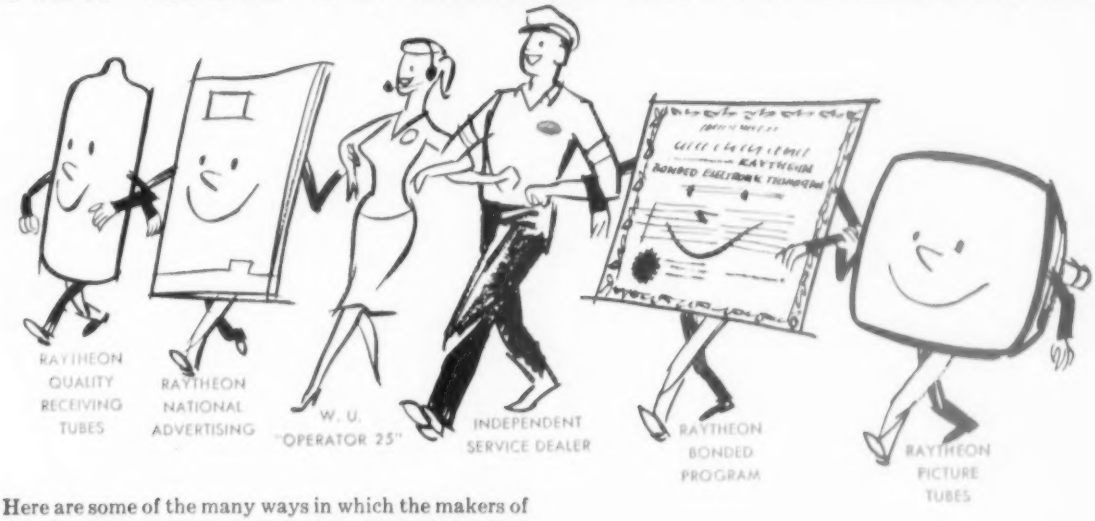
**Send today for literature and information on our complete line of equipment for Hotels, Motels, Apartments and Community Systems.**

**BENCO** TELEVISION ASSOCIATES LTD.
278 BRIDGELAND AVENUE, TORONTO 10, CANADA

MANUFACTURERS OF HIGH QUALITY COMMUNITY EQUIPMENT SINCE 1950

# How RAYTHEON Helps

# Independent Service Dealers with their TV-Radio Service Business




Here are some of the many ways in which the makers of Raytheon TV and Radio Tubes help the Independent Service Dealer with his business.

**1** For nearly *12 years* Raytheon has offered the Raytheon Bonded Electronic Technician program to Independent Service Dealers. Dealers who qualify have their service and parts guarantee backed by a bond issued through Continental Casualty Company, one of the country's largest insurance companies. It gives them real prestige in the eyes of the customer.

**2** Raytheon provides "Western Union Operator 25" service for Bonded Dealers in 23,000 cities and towns. In answer to phoned requests for fast, dependable, *bonded* TV-Radio service, "Operator 25" sends customers to Bonded Dealers.

**3** Raytheon consistently runs national advertising, presenting Independent Service Dealers as the best in the business.

**4** Raytheon has a network of *independent* distributors with well trained personnel who are eager to help *independent* dealers.

**5** Raytheon makes a complete line of TV and Radio Tubes that are tops for replacement work — Raytheon All-Set Tubes — designed to help the versatile service dealer who repairs all makes and models.

For the whole Raytheon story, get in touch with your nearest Raytheon Tube Distributor.

**TV-Radio service is *your* business . . . serving *you* is ours**

**RAYTHEON MANUFACTURING COMPANY**

*Receiving and Cathode Ray Tube Operations*

**Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.**

**Raytheon makes all these** { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

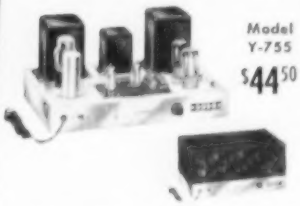
RAYTHEON

*Excellence in Electronics*

BUILD THE BEST—
BUILD ALLIED'S OWN
knight-kits®

Here is a typical Knight-Kit value—available only from ALLIED—one of 45 great Knight-Kits you'll find in our special Supplement No. 165. Write for your FREE copy today.

knight-kit HI-FI VALUE
25-WATT LINEAR-DELUXE AMPLIFIER KIT



Model Y-755
$44.50

Luxury quality at modest cost! Williamson-type circuit delivers 25 watts of virtually flawless response. Can be used with any tuner or preamp with a full set of controls (for volume, tone and equalization). Printed circuit wiring board for simplified assembly; balance control for precise matching of output tubes; variable damping control. *Response:* ± 0.5 db, 10-120,000 cps at 20 watts. *Harmonic Distortion:* 0.15% at 30 watts. *Intermodulation:* 0.4% at 20 watts. *Output Impedances:* 4, 8 and 16 ohms. 6¼ x 14 x 9" deep. Chrome-plated chassis. With all parts, tubes and easy-to-follow instructions. Shpg. wt., 25 lbs.

**Model Y-755**, Net, F.O.B. Chicago ..... $44.50
**Y-759**, Metal top cover for above ..... $4.25

OTHER knight-kit HI-FI VALUES

FM HI-FI TUNER KIT
Model Y-751
$37.75

10-WATT HI-FI AMPLIFIER KIT
Y-753 $23.50

20-WATT HI-FI AMPLIFIER KIT
Y-750 $35.75

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be happy, but comprehension and retention are not what they used to be. Electronics has been the gateway to many hidden treasures, it *could* lead to many more.

OLE B. RITCHEY
*Ex 8MS, W8EGT, WIVO, WIVA, WBLU*
*Metz, Ind.*

## ADDING A TAPE RECORDER

*Dear Editor:*

In my article "Adding a Tape Recorder," (February, 1957, issue of RADIO-ELECTRONICS), I tried to make the presentation as simple as possible for people confronted with this problem, without any competent instructor to help them out. But I omitted to mention *all* the factors involved, because I felt their inclusion might confuse the reader and be likely to "leave him where he came in." As there appear to be differences of opinion about such an approach, and I have received letters, the following short statement is offered to safeguard against possible misunderstanding.

The high-frequency losses in recording were not specifically mentioned, but, for simplicity, I grouped them all in one characteristic. There *are* head losses in recording, and the self-demagnetization of the tape also results in high-frequency loss, so constant current in the record head does not result in constant magnetization on the tape, especially above 1,000 or 1,500 cycles. It should also be stressed that the only *standard* curve for prerecorded tapes is the *playback* curve.

Some low-cost recorders use a variation in characteristics different from the one I showed, but with the same general purpose and very similar effect. Also some use another method of coupling in the high-frequency bias. I did not state that this is the only method, but that many use it. This was based on the examination of a number of schematics.

NORMAN H. CROWHURST
*Whitestone, N. Y.*

## SUGGESTION

*Dear Editor:*

The magazine now has several departments printed in each issue, including New Records, New Devices, New Tubes and Semiconductors, etc. I have often wondered why there isn't a Devices and Circuits I Would Like to See Them Make? This would consist of descriptive articles submitted by readers on new devices and circuits they would like to see. I am quite certain there are a number of readers who have ideas which would interest others. How about an answer on this?

JOHN A. COMSTOCK
*Wellsboro, Pa.*

(The suggestion is interesting. Let's have some requests from readers. What kind of circuit or device would you like to see?—*Editor*) END

Little Jack Horner
Sat in a corner
Listening to Hi-Fi

But his speaker was bad
And he was quite mad
For the music was naught
LOW nor HIGH

*Now* Little Jack Horner
Sits in a corner
His disposition's much
sweeter

For the music that swells
Is as clear as a bell
From his Twin-Cone
Norelco Speaker

*Norelco *FRS Speakers are available in 5", 8" or 12" sizes in standard impedances. Priced from $6.75 to $59.98. Blueprints are available for the do-it-yourself enclosure builder. Norelco Enclosures are available in three sizes, priced from $33.75 to $119.95.*

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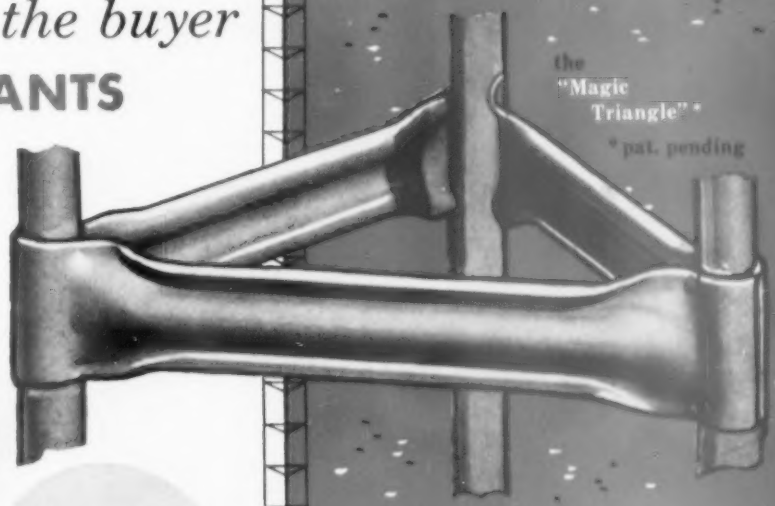
# ROHN towers

*Give what the buyer*

**WANTS**

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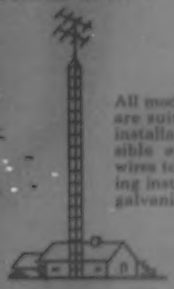
And, speaking of "similar" towers, there are NONE in existence. ROHN "Superior Design" Towers are far ahead with more exclusive features ... with more research ... with greater acceptance than any other tower!

See a ROHN Representative or Authorized Distributor for the FULL Rohn Story ... it's one you should know!



All models of Rohn Towers are suitable for home TV installations ... makes possible elimination of guy wires to give a self-supporting installation of gleaming galvanized steel!

Communication towers, heavy duty towers, fold-over towers are also available. The Rohn catalog shows a *complete* line including all types installation equipment, bases, roof towers, tubing and dozens of accessories.

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Peoria, Illinois

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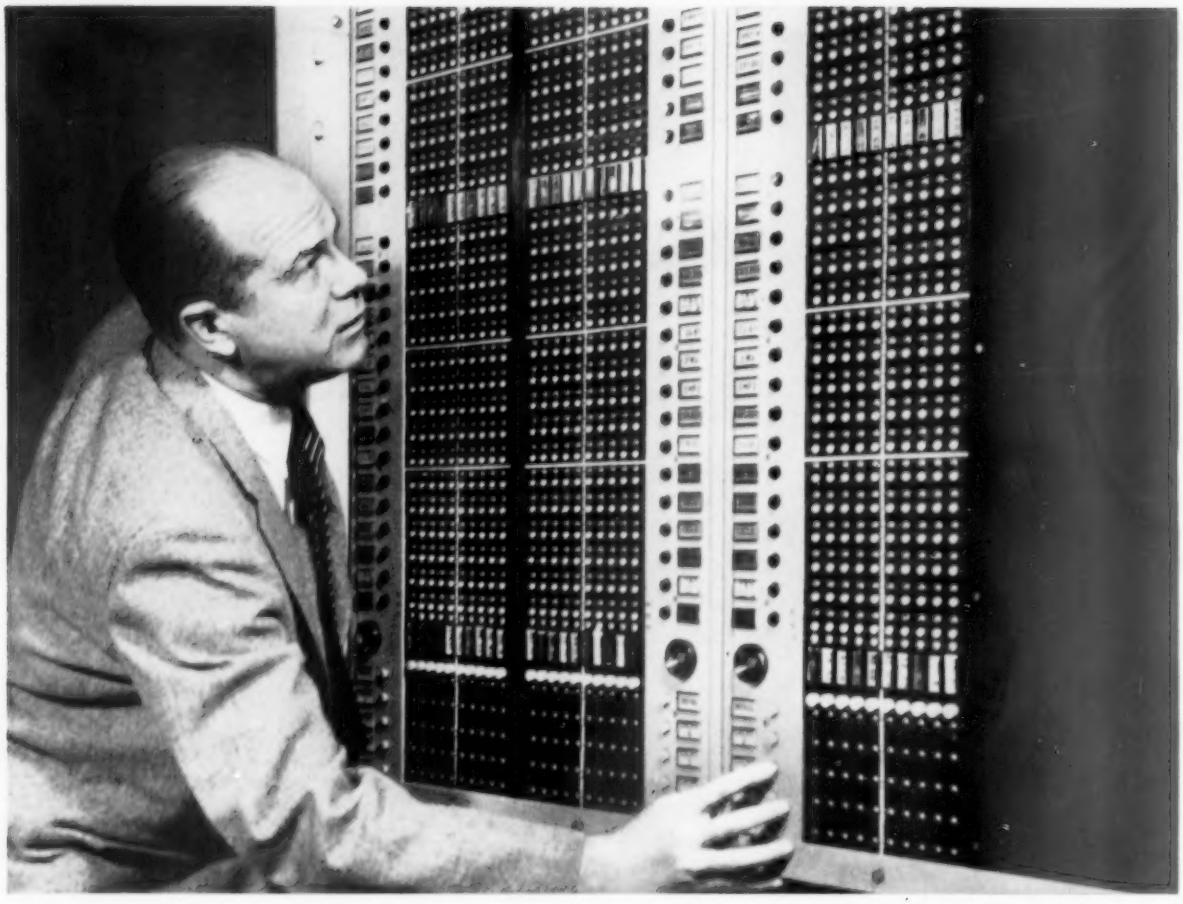

Bell Laboratories engineer Cyril A. Collins, B.S. in E.E., University of Washington, demonstrates new TV switching control panel for black and white or color. Complex switching connections are set up in advance; in a split-second a master button speeds dozens of programs to their destinations all over the nation. Special constant-impedance technique permits interconnection of any number of broadband circuits without picture impairment.

# Telephone science speeds TV enjoyment

Telephone science plays a crucial part in your TV entertainment. An interesting example—one of many—is the latest TV switching center developed at Bell Telephone Laboratories.

Switching centers control the transmission of programs which come to your local TV station over Bell System facilities. To be available exactly on cue, programs must be switched at high speed and with very great accuracy.

To create the new switching center Bell Laboratories engineers borrowed from the switching control art which handles your dial telephone calls. They developed a special control panel which puts complex switching patterns within the easy grasp of one man. By pushing buttons, he sets up—and double-checks—forthcoming network changes far ahead of time. On cue he presses a master button which sends the programs racing to their respective destinations around the nation.

To connect the broadband circuits, the Laboratories engineers developed a new video switch which operates on a constant-impedance principle. The new switch permits the interconnection of any number of circuits, without the slightest impairment of transmission quality.

Thus the technology which serves your telephone also works for your TV enjoyment.

BELL TELEPHONE LABORATORIES

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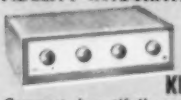
## *NEW!* 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

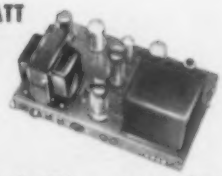


**with Preamplifier, Equalizer & Control Section**

**KIT $34.95 WIRED $57.95**

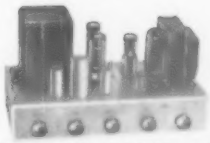
Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist:** **20 cps:** 2% @ 4.2 w; ½% @ 2.5 w; **30 cps:** 2% @ 11 w; ½% @ 6.3 w; **40 cps:** 1% @ 12 w; ½% @ 9.5 w; **2000 cps:** ½% @ 12 w; **10 kc:** 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 3⅝" x 12" x 8¼". 13 lbs. **COMING SOON**

## *NEW!* 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER



**HF50 KIT $57.95 WIRED $87.95**

Like the HF60 shown below, the HF50 features **virtually absolute stability, flawless transient response** under either resistive or reactive (speaker) load, **& no bounce or flutter** under pulsed conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.:** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps – 60 kc; ±0.1 db 15 cps – 30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching cover **Model E-2, $4.50.**



## *NEW!* 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52

**with Preamplifier, Equalizer & Control Section**

**KIT $69.95 WIRED $109.95**

Combines a power amplifier section **essentially identical** to the **HF50 power amplifier** with a **preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching cover **Model E-1, $4.50.**

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## HIGH FIDELITY PREAMPLIFIER

**#HF61A KIT $24.95, WIRED $37.95**

**With Power Supply: #HF61 KIT $29.95, WIRED $44.95**

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece-brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Senior "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) & **3 low-level inputs** (separate **front panel low-level input selector** permits concurrent use of changer & turntable). **Proper pick-up loading & atenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 8-100,000 cps; ±0.3 db 12-50,000 cps. **Extremely sensitive. Negligible** hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.

*NEW*

## 60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

**KIT $72.95 WIRED $99.95**

**Superlative** performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 3 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum:** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both **bias** and **DC — balance** adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 $4.50.**

*NEW*

## COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

**KIT $49.95 WIRED $79.95**

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (½ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; **2 low-level inputs** for proper loading with **all** cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs.
Matching cover **Model E-1, $4.50**

*NEW* **COMPLETE with FACTORY-BUILT CABINET — 2-WAY HI-FI SPEAKER SYSTEM #HFS1 $39.95**

Genuine 2-way book-shelf size speaker system. **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (**not** a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input — **Woofer:** ±4 db 80-1800 cps; **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. Power-handling capacity: 25 watts. Size: 23"x11"x9". 25 lbs. **Wiring Time:** 15 min.

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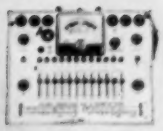
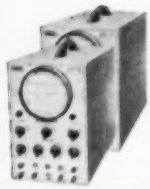


### NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 — WIRED $109.95

**COMPLETE with steel cover and handle.**

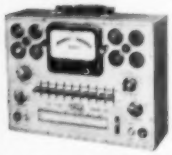
**SPEED**, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication** of Gm, Gp & peak emission. **Simultaneous** sel of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin, **10 pushbuttons:** rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**



**5" PUSH-PULL OSCILLOSCOPE #425**
*KIT $44.95*
**Wired $79.95**

•

**7" PUSH-PULL OSCILLOSCOPE #470**
*KIT $79.95*
**Wired $129.50**



**TUBE TESTER #625**
*KIT $34.95*
**Wired $49.95**

- tests 600 mil series string type tubes
- illuminated roll-chart

**Pix Tube Test Adapter** ..... **$4.50**

Sep. voltmeter & ammeter

*KIT $29.95*

**Wired $38.95**

**6V & 12V BATTERY ELIMINATOR & CHARGER #1050**

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.

*KIT $24.95*

**Wired $39.95**

**DELUXE MULTI-SIGNAL TRACER #147**

**20,000 Ohms/Volt MULTIMETER #565**
*KIT 24.95*
**Wired $29.95**

**1000 Ohms/Volt MULTIMETER #536**
*KIT $12.90*
**Wired $14.90**

Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd power factor.

*KIT $19.95*

**Wired $29.95**

**R-C BRIDGE & R-C-L COMPARATOR #950B**

| VTVM PROBES | KIT | Wired |
|---|---|---|
| Peak-to-Peak | $4.95 | $6.95 |
| RF | $3.75 | $4.95 |
| High Voltage Probe-1 | | $6.95 |
| High Voltage Probe-2 | | $4.95 |
| **SCOPE PROBES** | | |
| Demodulator | $3.75 | $5.75 |
| Direct | $2.75 | $3.95 |
| Low Capacity | $3.75 | $5.75 |

### NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 — WIRED $119.95

**Entirely electronic** sweep circuit (no mechanical devices) with accurately-biased **increductor for** excellent linearity. **Extremely flat RF output: new AGC circuit** automatically adjusts osc. for max. output on each band with min. ampl. variations. **Exceptional tuning accuracy:** edge-lit hairlines eliminate parallax. **Swept Osc. Range** 3-216 mc in **5 fund. bands. Variable Marker Range** 2-75 mc in **5 fund. bands;** 60-225 mc on harmonic band. **4.5 mc Xtal Marker Osc., xtal supplied.** Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

### NEW! COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 — WIRED $129.50

**• Features DC Amplifiers!**

Flat from DC-4.5 mc, usable to 10 mc. **VERT. AMPL.:** sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull **thruout;** K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. **SWEEP:** perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); **preset TV V & H positions;** auto. sync. ampl. & lim. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

### NEW! RF SIGNAL GENERATOR #324

KIT $26.95 — WIRED $39.95

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# U. S. GOVERNMENT NEEDS INVENTIONS

## . . . *Many Electronic Inventions Still Require Development* . . .

TO those who believe that everything worth while has been invented, we wish to point out that the opposite is true.

Your Government is constantly looking for new devices, largely electronic inventions and new developments. These pertain primarily to technical problems affecting national defense. The agency in charge of these developments is the National Inventors Council, Charles F. Kettering, chairman.

We give below a list of inventions desired. No special forms are required for submitting proposals to the council. Each proposal should be submitted as a separate document, typewritten if possible. Descriptions should be as nearly complete as possible and might include: (1) some reference to the principles underlying the apparatus, (2) a discussion of any experimental work or tests that have been conducted and (3) the particular points of novelty or superiority of the invention as compared to existing devices or practices. If sketches or drawings are necessary, include these too. Drawings need not necessarily be done professionally. You should, however, retain copies of all items presented, as Government regulations do not permit return of material once it has been received.

Address all proposals to: The National Inventors Council U.S. Department of Commerce, Washington 25, D. C.

*534. RADIO-PROOF BLASTING CAP.* An inexpensive and efficient electric blasting cap which cannot be initiated by electromagnetic radio or radar waves.

*538. COAXIAL rf SWITCH.* Coaxial rf switch of broadband characteristics to handle 1 to 10 kw of power.

*541. MICROWAVE DIRECT-STORAGE OR MEMORY CIRCUIT.* Microwave direct-storage or memory circuit in which the frequency and/or modulation may be read off after a time delay of 1 to 100 seconds.

*542. NONHETERODYNING TYPE OF FREQUENCY DIVIDER.* A nonheterodyning type of frequency divider for microwave frequencies.

*545. SEMICONDUCTOR MATERIAL.* Develop a semiconductor material suitable for use in transistors, the color of which is to depend upon its conductivity type; that is, n-type material one color, p-type material a different color.

*653. BROAD-BAND DETECTORS.* Broad-band detectors for hf, vhf, uhf, centimeter and millimeter wavelengths with sensitivities 10 to 40 db better than present crystal detector.

*654. CAPACITORS.* Capacitors which will operate at 200° C continuously, preferably of small size, for applications which require performance at established electrical ratings over a wide temperature range of −55° C to +200° C.

*656. RADAR PERFORMANCE MEASUREMENT. Scope.*—Development of a simple means or method to measure the performance of radar systems operating above 10,000 megacycles. *Present situation.*—Echo boxes and their radar ring time are used to measure frequency, relative power output and spectrum of the radar transmitter and also indicate the merit of receiver sensitivity. At the higher frequencies, echo boxes have inherent limitations which make their use impracticable.

*657. WIRELESS POWER TRANSMISSION.* The development of a technique whereby an appreciable amount of power (1,000 watts) may be transmitted without the use of cables up to a distance of 50 miles and, in addition, techniques for accepting this power at the receiving end in a useable form.

*658. AMPLIFIER.* An amplifying device suitable for use in servo systems capable of operating reliably at 500° C.

*662. MICROWAVE FREQUENCY DISCRIMINATOR.* There is interest in a frequency discriminator which would be useful and practical in laboratory microwave oscillator measurements.

*699. THERMIONIC OR COLD EMITTER.* Devise a thermionic emitter or cold emitter capable of greatly increased efficiency and suitable for use as a cathode in the usual thermionic electron tube.

*701. BROAD-BAND AMPLIFIER.* An amplifier with high gain and with bandwidth for frequencies up to and including uhf, of lightweight, rugged and reliable design, having relatively simple low-drain power supply requirements.

*712. HEAT DISSIPATION IN ELECTRONIC ASSEMBLIES.* The high incident temperatures in small electronic devices requires a new means of cooling such devices other than conventional means which require electrical energy and comparatively large cooling devices, such as blowers, fans, etc. A static device or material is needed to serve as a heat rectifier to provide unidirectional transfer of heat or a unidirectional heat exchanger.

*713. QUARTZ CRYSTAL UNITS. a.* Develop means whereby quartz crystal unit aging is minimized in order to meet the increasingly stringent requirements of military electronic equipment, where stabilities of 1 in 109 per week or better are required. *b.* Develop quartz crystal units which must function reliably at temperatures up to 300° C and higher with stabilities of at least .005% for use in equipment used in high-speed aircraft and guided missiles.

*716. METEOROLOGICAL SOUNDING EQUIPMENT.* Determine the feasibility of developing equipment to obtain soundings of the atmosphere (temperature, pressure and relative humidity to 100,000 feet or greater) without using airborne instruments such as radiosondes. The equipment is to be ground-based and is to be portable.

*717. RADAR RESOLUTION OF TARGETS.* Methods are needed for separating each aircraft in a close formation.

*718. RADAR DISPLAYS.* Improvements in displaying radar data are needed so that more accuracy and resolution are obtainable. Variable-persistence cathode-ray tubes would also be desirable if they can be effected simply.

*719. RADAR-DATA PROCESSING.* Simple methods for deriving target velocity and continuously maintaining target position tracks are needed.

*720. RADAR THREE-DIMENSIONAL COVERAGE.* A variety of problems exist in effectively utilizing a radar to give accurate height data as well as range and asimuth.

*721. RADAR-RANGE PERFORMANCE.* As potential enemy targets become smaller and their velocity increases, the desired radar range becomes increasingly difficult to achieve. Brute-force techniques for overcoming this problem such as higher power outputs and larger antennas have limitations which are being approached. New techniques are needed for overcoming this problem.

*722. RADAR CLUTTER.* Moving targets are masked by return from relatively stationary objects. There has been considerable work done in fields of MTI (Moving Target Indicators) to combat this problem, but substantial improvement in MTI techniques is still needed.

*723. RADAR LINE-OF-SIGHT LIMITATION.* One of the most difficult problems in getting good radar coverage is caused by the fact that the radiated energy will not conform to the Earth's curvature so that targets below the tangent line between the radar antenna and the Earth are generally not visible to the radar. Methods for overcoming this limitation are needed.

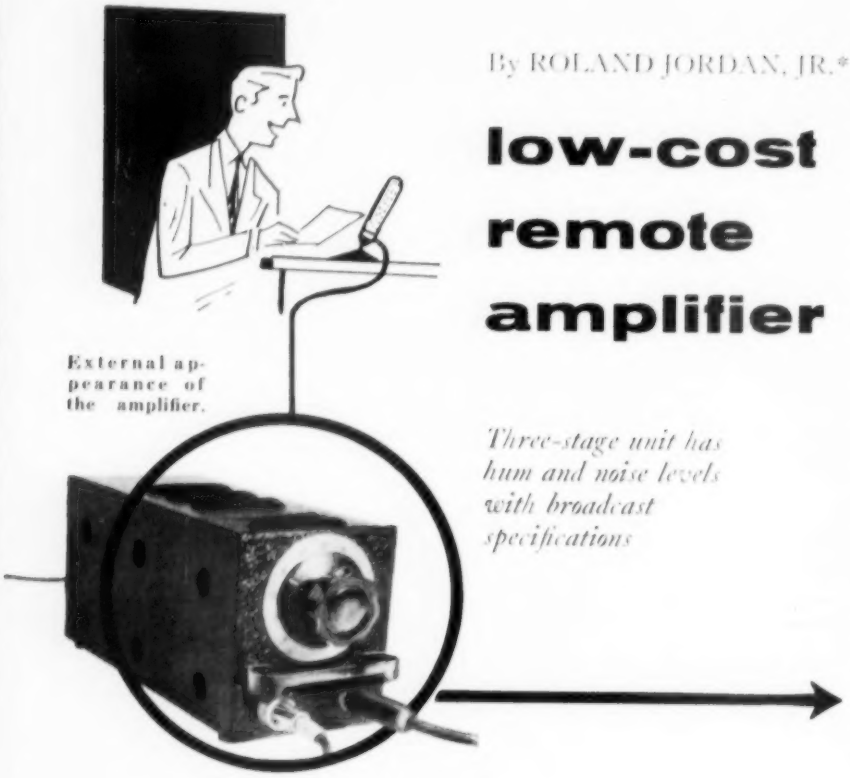
*BLUE-SKY PROBLEMS.* "We describe a problem as 'blue sky' when we suspect it will take imaginative, sky-is-the-limit thinking to solve it," explains John C. Green, director of the Office of Technical Services and the council's executive director. "The man who cracks one of these puzzles won't be bound by traditional barriers between sciences. He may have to be the modern equivalent of an Edison or Marconi—or even a Houdini."

*EXPLOSIVE MINE DETECTOR.* A method for locating explosives buried at shallow depths below the Earth's surface. Present detectors locate the explosive's container or signal the presence of a hole in the ground.

*METHOD FOR CONVERTING LIGHT INTO ELECTRICAL ENERGY.* An invention which will convert a small amount of light into enough electricity to operate electrical equipment. Far greater power output is needed than has as yet been supplied by solar batteries.

*DESTRUCTIVE RAY OR WAVE.* Equipment of usable size capable of producing death rays effective at 500 yards—without excessive power input. Investigations so far indicate that a completely new approach is needed.

It is suggested that you write for the *complete* list of inventions wanted—the list printed here gives only electronic problems. For address, see first part of article. —*H.G.*



External appearance of the amplifier.

By ROLAND JORDAN, JR.*

# low-cost remote amplifier

*Three-stage unit has hum and noise levels with broadcast specifications*

NECESSITY is the mother of invention, so the old saying goes, and so it was that the design of this remote amplifier evolved from the need for a small, lightweight unit. It was to be used on occasions when the larger, heavier and more elaborate Dual-Channel Remote Amplifier (February, 1953, RADIO-ELECTRONICS) was not needed or when it was in use at another location.

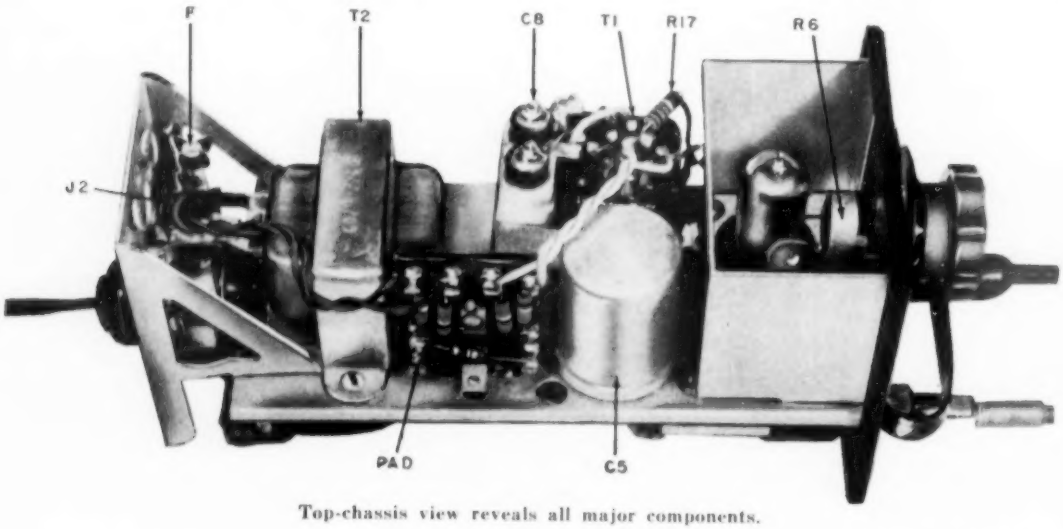
*Radio WRWJ, Selma, Ala.

Most any broadcast engineer can tell you that a large part of the remotes he is called on to cover can be handled with a single mike and a single-channel remote amplifier. If he has been around a small town independent station very long, he can also tell you that funds for such a project are seldom very plentiful. This then was to be a "bargain-basement" job and to be as small and light as possible and still meet broadcast standards. I built the remote unit on a surplus turbo-supercharger amplifier (see photos). These may still be available on the surplus market and are ideal for the job once the original parts have been removed. However, any suitable chassis can be used.

The amplifier is straightforward in most respects. Both the 5879 and the 12AY7 are audio tubes, and their superior performance and small size make them a natural for this amplifier. As the diagram indicates, the only concession made to obtain the small size of the unit was the high-impedance input. There simply was not enough room to put an input transformer in the amplifier in a place where it would not pick up hum from the power transformer. Since there are many good broadcast microphones on the market that have both high- and low-impedance outputs, this was not considered too great a handicap. (I use a 726 E-V cardioid for music and a crystal mike for speech remotes, and it works out fine.)

The cathode of the 5879 is heavily bypassed to reduce hum. The plate and screen load resistors in this stage are low-noise precision units and their use is definitely worth while if you intend to keep the noise level low enough for broadcast use. The Continental Nobeloy 1% resistors do a very fine job at low cost in this application, and one was also used in the plate circuit of the second amplifier stage. This stage has no cathode bypass nor is it decoupled in the plate circuit from the last amplifier stage since space was at a premium. No ill effects have been caused by these omissions and there is absolutely no tendency toward motorboating or instability. The 1-$\mu$f capacitor in the plate circuit of the output stage is a surplus oil-filled unit which blocks dc from the primary of the UTC A-24 output transformer.

To save space, a voltage-doubler circuit was used with two small selenium rectifiers and a small 1-to-1 power transformer. This is entirely practical




Top-chassis view reveals all major components.

since the total B-supply drain is only 6 ma. Because of this low current drain the voltage at the output of the filter section is somewhat higher than would ordinarily be expected and is more than adequate for these tubes.

The 4-db pad in the output circuit is standard practice to isolate the output stage from any line-impedance variations. Or, as I heard a man express it once, to make the amplifier think it is feeding a purely resistive load and to make the line think it is being fed from Boulder Dam.

The tubes of the amplifier are inside the original shield as is the volume control. The original socket holes inside this shield were made slightly larger with a standard socket punch, and new nine-pin sockets were installed. Coupling capacitor C3 was soldered to the volume control before it was installed on the front panel as were the other two volume control leads. C3 goes through a slot that was already in the chassis.

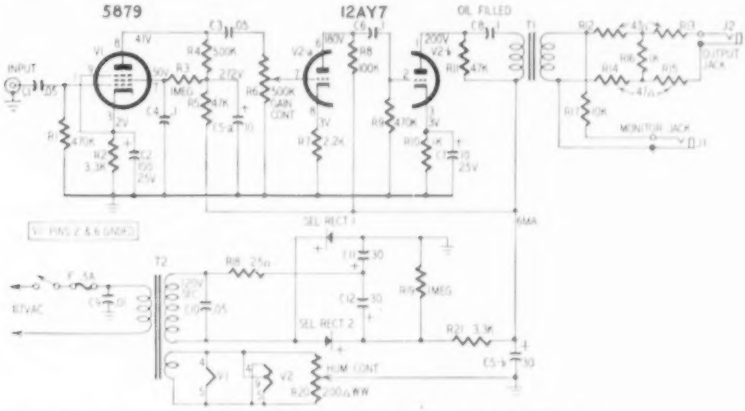
Leaky coupling capacitors, because of the extreme dampness, are a problem on the Florida coast where this amplifier was built and for this reason flat-plate ceramic units were used for C3 and C6. The top-view photo shows the terminal board for the output pad resistors and shows how the 1-μf capacitor was mounted by taping it to the output transformer. The ac input receptacle is shown at the extreme rear of the amplifier with the output jack just above it.

A short heavy ground bus was used. (See bottom-view photo.) This view also shows the mike input connector, the phone jack, the flat ceramic and filter capacitors and the hum balancing pot. No ac switch was used, partly because of lack of space on the front panel and partly because I did not want any high-level ac source near the input stages to cause hum. The small louver at the bottom of the front panel was pressed closed in a vise so that the mike connector and the phone jack could be mounted below the handle on a flat surface.

To finish it off, the metal skirt was removed from the volume-control knob and bolted to the panel. This turned out to be a bigger job than you might think, but it can be done. The cabinet is well ventilated and the amplifier can be used for hours and still be only barely warm. A quarter-turn on the fastener at the back of the case permits the unit to be removed.

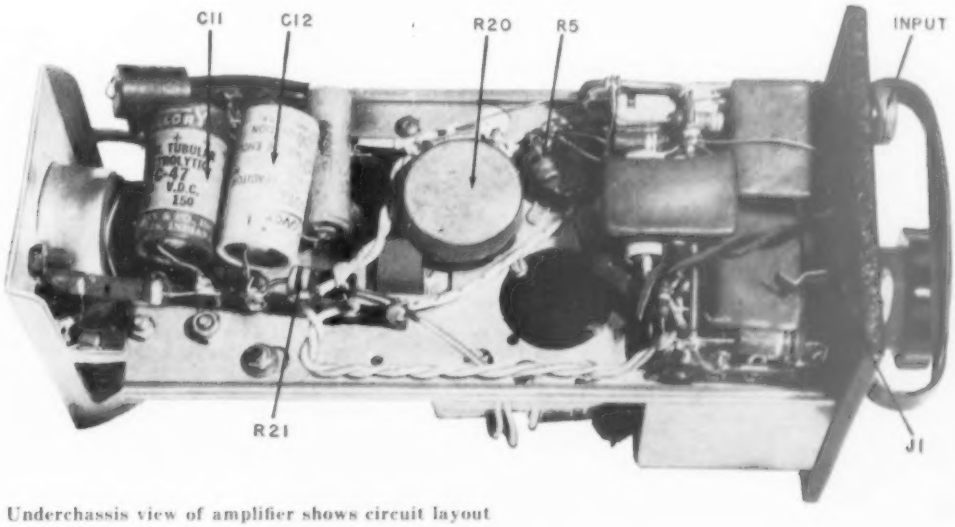
This remote amplifier costs very little in comparison to an equivalent commercial unit, primarily because most of the power supply components were obtained from the "bargain-basement" pages of catalogs.

The quality of the unit is very good and the total hum and noise level is 58 db below a plus-4-db output, which is well within broadcast specifications. The three stages provide more than enough gain for even the lowest-level broadcast mikes. All parts are easily obtainable and most of them can be purchased at very low cost. END




R1, 9—470,000 ohms
R2—3,300 ohms
R3—1 megohm, 1%, low noise (see text)
R4—500,000 ohms, 1%, low noise (see text)
R5, 11—47,000 ohms
R6—500,000-ohm pot, audio taper
R7—2,200 ohms
R8—100,000 ohms, 1%, low noise (see text)
R10—1,000 ohms
R12, 13, 14, 15—47 ohms, ½ watt
R16—1,000 ohms
R17—10,000 ohms
R18—25-27 ohms
R19—1 megohm
R20—200-ohm wirewound hum-balancing pot
R21—3,300 ohms, 2 watts
*All resistors 1 watt unless noted*
C1, 3, 10—.05 μf
C2—100 μf, 25 volts, electrolytic
C4, 6—0.1 μf
C5—10-30 μf, 250-350 volts, electrolytic
C7—25 μf, 25 volts, electrolytic
C8—1 μf (preferably oil filled)
C9—.01 μf
C11, 12—30 μf, 150 volts, electrolytic
*All capacitors 600 volts unless noted*
T1—output transformer, primary 15,000 ohms, secondary 50, 125-150, 200-250, 333, 500-600 ohms (UTC A-24 or equivalent)
T2—isolation transformer, secondary 120 volts and 6.3 volts @ 1 amp
V1—5879
V2—12AY7
Sockets, 9-pin miniature (2)
SEL RECT 1, 2—50-ma selenium rectifiers
J1, 2—open-circuit phone jacks
F—½-amp fuse and holder
Chassis type mike connector
Receptacle, ac
Dial and knob
Chassis or cabinet

**Schematic diagram of the three-stage low-cost remote amplifier.**




**Underchassis view of amplifier shows circuit layout**

*Part II—More variable-reluctance cartridges*

# modern phonograph cartridges

By JULIAN D. HIRSCH

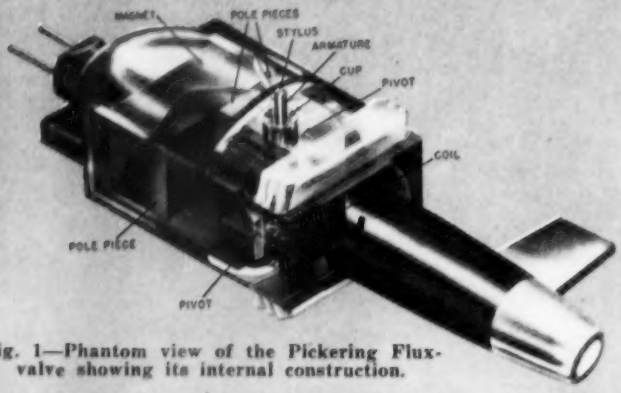



**Fig. 1—Phantom view of the Pickering Fluxvalve showing its internal construction.**

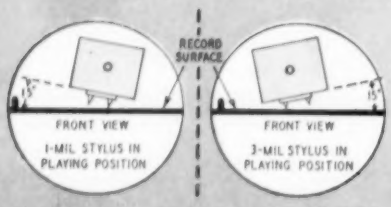



**Fig. 2—Method of selecting styli with a Fen-tone B&O 350A+.**

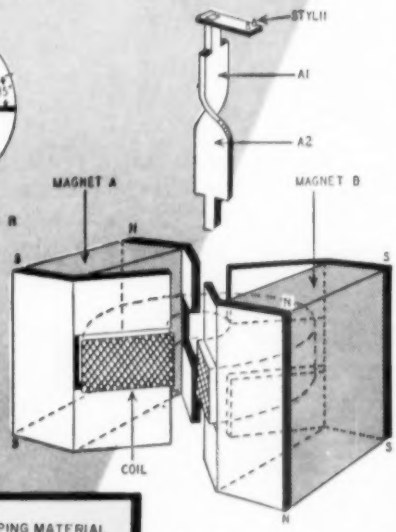



**Fig. 3—Exploded sectional view of the Fen-tone B&O 350+.**

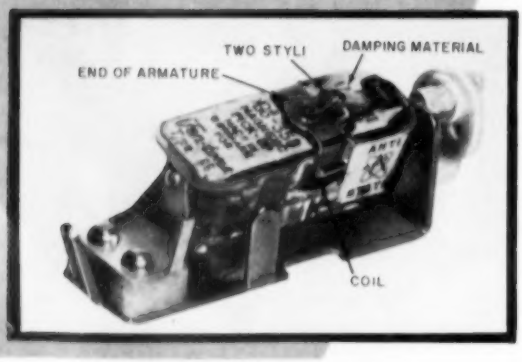



**Fig. 4—Fen-tone B&O 350+ cartridge in its mounting strip.**

IN our first article we described some of the popular variable-reluctance cartridges. This month we will continue with our description of this type of cartridge.

A variable-reluctance cartridge is a velocity-responding magnetic cartridge of the moving-iron type.

## Pickering Fluxvalve

The Pickering Fluxvalve represents a radical departure from earlier types of magnetic pickups, in its physical construction, although it is still basically a variable-reluctance cartridge. It was described completely in an article in this magazine May, 1956, and will be discussed very briefly here.

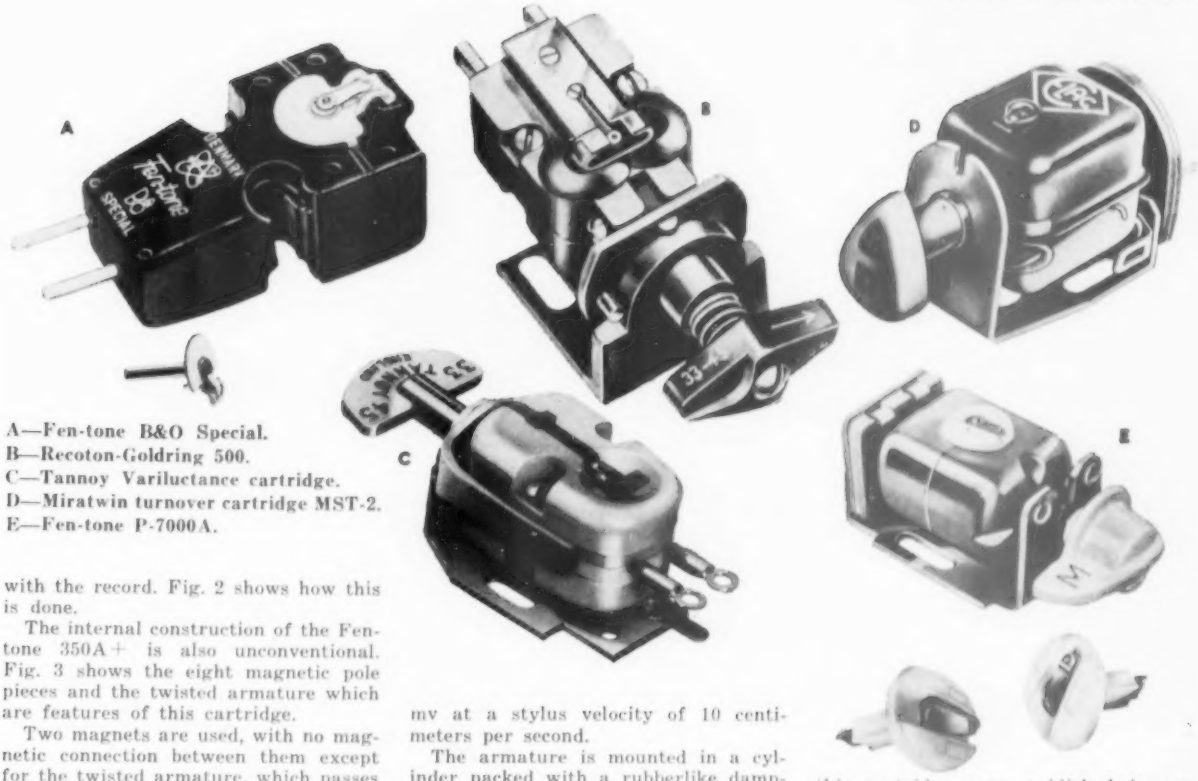
The Fluxvalve is a turnover cartridge with two styli mounted 180° apart. Fig. 1 is a phantom view showing the Fluxvalve's internal construction.

The stylus assembly can be slid in or out of the cartridge body without the use of tools and without removing the cartridge from the arm. In addition to the usual 1- and 3-mil styli, Pickering offers a ½-mil stylus which may give superior reproduction on many of the newer records which are cut with so-called "V-grooves." Like the Audax, the Fluxvalve will operate equally well with one or two styli inserted, since they have separate magnetic systems.

The cartridge's output is relatively high, about 25 mv at a stylus velocity of 10 centimeters per second and a frequency of 1 kc.

## Fen-Tone B&O 350 A+

An unusual-looking import from Denmark is the Fen-tone 350A+. It is constructed with a clear plastic body and features a stylus assembly in which the 1- and 3-mil styli are mounted side by side at the end of a single cantilever bar. Each stylus jewel is at an angle of 15° to the vertical axis, and the entire cartridge body is rotated 30° to place one or the other in contact




**A—Fen-tone B&O Special.**
**B—Recoton-Goldring 500.**
**C—Tannoy Variluctance cartridge.**
**D—Miratwin turnover cartridge MST-2.**
**E—Fen-tone P-7000A.**

with the record. Fig. 2 shows how this is done.

The internal construction of the Fen-tone 350A+ is also unconventional. Fig. 3 shows the eight magnetic pole pieces and the twisted armature which are features of this cartridge.

Two magnets are used, with no magnetic connection between them except for the twisted armature, which passes through the single coil. The two sections A1 and A2 of the armature are 90° to each other. They are located between the upper and lower sets of pole pieces, respectively. In the neutral position of the stylus, the armature sections are equidistant from the pole pieces. Flux passes between the upper N and S poles of each magnet without linking the coil, and any flux going from the upper N to the lower S pole of magnet A is neutralized by an equal and opposite flux from the lower N to the upper S pole of magnet B.

Lateral stylus movement rotates the armature about its vertical axis. When one edge of section A1 is closer to the upper N pole of magnet A, one edge of section A2 is brought closer to the lower S pole of magnet A. This causes magnetic flux to pass through the armature and link the coil turns. At the same time an equal amount of flux in the same direction is contributed by magnet B. Moving the stylus in the opposite direction has a similar effect, with opposite flux polarity. Thus the requirements for generating a voltage in the coil have been met, with a completely different physical construction from any of the other cartridges we have described.

The design of the Fen-tone B&O 350A+ offers several advantages. The use of eight pole pieces and a relatively long armature means that a large amount of flux variation can be achieved with a small stylus movement, without using an excessive number of turns in the coil. The output of this cartridge is in the neighborhood of 60 mv at a stylus velocity of 10 centimeters per second.

The armature is mounted in a cylinder packed with a rubberlike damping material. Vertical stylus movement cannot cause any armature rotation, so the vertical response of this cartridge is very low. Replacement of the stylus is very simple. The cylinder containing the armature slips into a hole in the plastic body between the ends of the pole pieces.

Fig. 4 shows the entire cartridge in its mounting clip. A strip of damping material is attached to the end of the stylus shoe. This is a part of the stylus assembly and is replaced when the stylus is replaced. Also visible in this picture are the two styli, the end of the armature, and the coil in the center of the body.

Due to the low impedance of the coil, the resistive termination of this cartridge is not critical. The lateral compliance is high and the effective moving mass is quite low, considering the fact that the mass of two styli must be moved. A single-stylus version of this cartridge is also available.

A small piece of radioactive material is attached near the front of the cartridge. It is claimed that this ionizes the air in the vicinity of the stylus so that after a few playings it will not have any static charge to attract dust particles.

The B&O 350A+ can be mounted in most record changer plug-in shells and many tone arms. It is rather long and several high quality arms will not accommodate it. The Fen-tone B&O Special is designed on the same principles but will fit any standard tone arm having ½-inch mounting centers. Performance data, including curves, on this cartridge were published in our April, 1956, issue on page 49.

## Other variable-reluctance types

Although the cartridges we have described represent only a fraction of the variable-reluctance types available today, they illustrate the basic design variations used in all others. Space considerations prevent us from describing many of these cartridges in detail, but we will mention a few and indicate their similarities to others.

First, there are the cartridges in which a cantilever stylus bar carries the magnetic field from one end of a magnet through a pair of pole pieces and back to the other end of the magnet. The G-E cartridge is this type.

The well known Recoton-Goldring cartridges operate in the same manner, including the use of two coils connected in a hum-bucking arrangement. It is a true turnover type, with completely separate pole pieces and styli mounted on opposite sides of the cartridge.

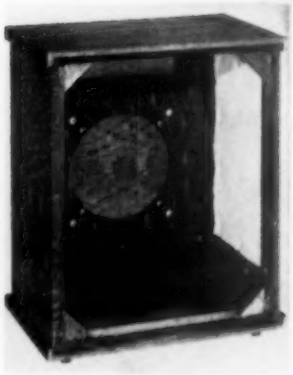
The Tannoy Variluctance cartridge is also of this type, except that its stylus assembly is removable without the use of any tools.

Two cartridges of West German manufacture, the Miratwin and the Fen-tone P-7000A, resemble the Fen-tone B&O 350+ in stylus and armature design. They both use a cantilever stylus shoe which rotates a relatively long armature about a vertical axis. Both are turnover types, with individually replaceable styli. The Miratwin is available in a single-stylus model.

TO BE CONTINUED

COVER FEATURE

*New techniques and wide selections make the kit builder's lot easy*



**Above—Putting the final panels on a prefinished Cabinart kit. Left—A *Californian* enclosure just before the back goes on.**

# Enclosure Kits Aid Audio Builders

By ERIC LESLIE

FROM the earliest days of radio, the do-it-yourself electronician has always been active. He has been impelled by three motives: The man (or boy) with limited funds and ample time has found it possible to construct equipment he might not have been able to buy; the experimenter found an opportunity to learn by doing; the perfectionist was able to build equipment to meet his own exacting specifications and containing features not always obtainable in commercial models.

The large number of kits on the market has resulted in a resurgence of home construction. This is true in the audio field especially. The true lover of music can, with a good kit-constructed amplifier and preamplifier feeding into a self-assembled speaker-enclosure system, enjoy reproduction no whit inferior to that of his neighbors with the costliest of commercial audio setups.

With the coming of prefinished enclosure kits—as illustrated on our cover this month—a last objection to the home-built speaker enclosure disappeared. The appearance of the self-assembled system can now match that of the best store-bought job. The job of finishing.

A glittering selection of enclosures is now available to the enthusiast. (The majority, of course, are in the unfinished form.) The table printed in connection with this article gives a fair idea of what is obtainable, though no such table can claim to be complete and exhaustive. A number of speaker manufacturers have offered enclosure kits from time to time, and some who are now doing so may have escaped our knowledge. New firms are springing up, and some small companies are doing an excellent business without wide advertising.

The selection is greater in another way than the table would indicate: Speaker enclosures are flexible by their very nature. There are many ways to reproduce a sound. Enclosures intended for three speakers may well work with two or one, especially since combination speakers with two or three ranges are available. And if a model is constructed for use with one speaker, a slit for a tweeter horn can usually be sawed in it without damaging quality of reproduction. Enclosures with 15-inch cutouts are provided with adapters for 12-inch speakers, and those with two speaker cutouts are supplied with cover plates so the system will work with one speaker, unless or until the owner desires a second.

The opportunity to start small and work up to bigger and better things is an added attraction to the do-it-yourself audio enthusiast. More than one company points out this opportunity, one (University) makes it a central feature, using the term PSE (Progressive Speaker Expansion) in connection with a number of its units and kits.

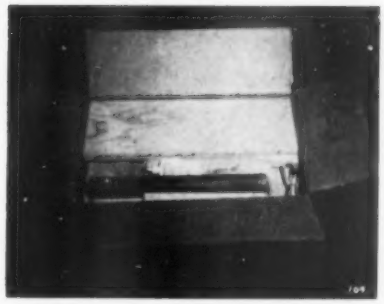
The variety of possibilities may even add up to mild confusion in some cases, and the neophyte can be puzzled as to whether he will be better off with a three-way speaker system in his enclosure or whether—balancing cost against desired quality—he might not be better advised to install a single tri-axial unit.

There is no definite answer to such a question, and even the difference between single, dual and triple speakers is lessening. For example, the *Electro-Voice Radax* speakers have two cones with one voice coil, using a mechanical crossover to divide the frequency range between the two cones. The same company's mid-range speakers may consist of two horns, a reflexed one and a short straight unit, working from the back and front of the same diaphragm. Thus with three speaker units, using three voice coils, and a three-way crossover network, the audio enthusiast may have a virtual five-way reproducing system.

As to which is best: with a few outstanding exceptions, all agree that the ultimate is achieved with separate speakers for each range, but few and timid are the estimates as to how much better is a good three-speaker system than a three-way system with two speakers, or even an excellent tri-axial or other wide-range unit.

Construction of kit type equipment has been tremendously simplified. Little cabinetry is required with the precut kit. A hammer is featured as the important instrument in some instruction books and sheets—a screwdriver is included with other kits. Careful gluing is still an essential, and the occasional warped piece (it can happen!) presents problems. Care in handling and mounting heavy speakers is essential—it's as easy as ever to put a screwdriver through a speaker cone, and there is no way of patching a cone and still retaining anything approaching fidelity.

The table is intended only to survey the field and give some ideas as to what is available to the intelligent enthusiast. As stated, it makes no pretension to completeness, either as to models covered or to technical detail. The variations between enclosures is such as to make tabulation more of an introduction to than a complete exposition of the speakers. Two folded horns may resemble each other very little in construction details. And some of the items listed, such as the Heath, are



**A kit in package form. This one is one of the Electro-Voice enclosures.**

complete systems including speakers and enclosures, complete with cross-over networks and a manual of instructions for assembling the enclosures and wiring the speaker systems. Some of the Klipsch-Cabinart enclosures, on the other hand, offer the purchaser his choice between a speaker board with cutouts for speakers or a complete preassembled, prewired and mounted speaker system, ready for installing in the enclosure.

The more daring craftsman may go one step beyond the kit. Both the Electro-Voice and the Karlson instruction booklets give instructions and specifications for cutting your own lumber to fit (though these books also point out respectfully that, if you are more interested in good sound than in cabinet-making, the precut kits will not only save time but will insure better output quality). These instructions are available at prices from 75c to $8.50 (the latter including full-size working drawings). Jensen issues a large booklet for 50c, detailing the construction of 18 Jensen enclosures, and speaker manufacturers regularly send out leaflets on enclosures suitable for their products. One recently received from Racon Electric Co. is a four-page brochure with plans for four enclosures, ranging from a small dual-speaker setup to a true corner horn. Many articles on enclosures also appear in the various audio magazines and books. Original designs are being introduced continually, and the field is one to fascinate the acoustical experimenter as well as the audio enthusiast. END

**Footnotes for Kit Specification Table**

PFK in Cabinart model numbers indicates prefinished kits. PFM and PFB are prefinished mahogany and blond, respectively, in Knight Quik-Craft models. P indicates a dress kit which may be added to the unfinished Jensen enclosure of similar model number.

[1] Kits are normally supplied with two-hole baffle—may also be used with Klipsch three-way system already assembled on a mounting board.

[2] The Ultraflex design is a special type of duct-loaded bass reflex.

[3] Where one speaker is recommended, a tri-axial type is understood.

[4] Includes two speakers.

[5] Includes three speakers.

[6] Also available prefinished, in three finishes, prices ranging from $63.75 to 79.50, and in Converti-Base type, usable as highboy or lowboy.

[7] Includes speakers.

[8] Also available with speaker, as B-12-S, $29.95.

[9] Adapter boards provided for additional or other-size speakers.

# KIT SPECIFICATIONS

## Cabinart (G & H Wood Products Co., Inc.), Brooklyn 11, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| 8125 | 33½ x 23 x 16 | 1 | Bass reflex | 12 or 15 | $21.00 | |
| 61. PFK 610 | 31⅞ x 31½ x 16 | 1 | Folded horn | 12 | 19.95; PFK 25.95 | |
| 63. PFK | 31⅞ x 34½ x 17 | 1 | " " | 15 | 23.95; PFK 29.95 | |
| K-12. PFK 120 | 32 x 20⅞ x 14½ | 2[1] | " " | 12 | 36.00; PFK 48.00 | |
| K-15. PFK 150 | 32 x 23⅞ x 16½ | 2[1] | " " | 15 | 42.00; PFK 58.00 | |
| K-3. PFK 300 | 36½ x 25¾ x 22½ | 2[1] | " " | 15 | 49.00; PFK 72.00 | |
| K-5. PFK 500 | 21¼ x 16⅛ x 14¾ | 1[3] | " " | 12 | 24.00; PFK 36.00 | |

## Jensen-Cabinart, Chicago, Ill.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| K-101 Imperial | 53 x 34 x 25 | 1 or 3 | Folded horn | 15 | 89.00; P-201 54.00 | |
| K-103 Tri-Plex | 40½ x 27⅛ x 19½ | 1, 2, 3 | Ultraflex[2] | 15 | 48.00; P-203 39.00 | |
| K-105 Low-Boy | 34¾ x 36½ x 18¼ | " | " | 15 | 48.00; P-205 39.00 | |
| K-107 Concerto | 32⅞ x 24½ x 17¾ | 1, 2 | " | 12 | 39.00; P-207 36.00 | |
| K-109 | 31 x 31¼ x 16¼ | " | " | 12 | 39.00; P-209 36.00 | |
| K-111 | 26 x 19¼ x 14½ | " | " | 8 | 23.00; P-211 25.00 | |
| K-113 Duette | 13 x 25½ x 10¼ | " | Special | 8 | 18.00; P-213 21.00 | |

## Electro-Voice, Inc., Buchanan, Mich.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| KD1 Patrician | 44¾ x 34½ x 23⅜ | 5 | All are types of folded horns | 18 | 99.00 | Model 107 finishing shell available for Georgian |
| KD2 Georgian | 37½ x 26¾ x 22 | 3 | | 15 | 58.00 | |
| KD3 Centurion | 38⅞ x 28 x 21¼ | 3 | | 15 | 79.00 | |
| KD4 Regency | 27⅞ x 32½ x 18¼ | 2 or 3 | | 15 | 69.00 | |
| KD5 Empire | 25⅜ x 31 x 15¼ | 1[4], 2 or 3 | | 15 | 48.00 | |
| KD6 Aristocrat | 27⅞ x 19 x 15¼ | 2 or 3 | | 12 | 36.00 | |
| KD7 Baronet | 21⅜ x 13 x 12⅞ | 1[5] or 2 | | 8 | 24.00 | |

## Allied Radio, Chicago, Ill. (Knight, Quik-Craft)

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| 95 DZ 597 | 33¾ x 35¾ x 18½ | 1[9] | Corner enclosure | 12 or 15 | 24.00; F 27.95 | |
| 95 DZ 595 | 26 x 34 x 16 | 1[9] | Bass reflex | 15 | 36.95 | |
| 12U, -PFM, -PFB | 32 x 21 x 14½ | 1[3] | Folded horn | 12 | 34.95; PFM, PFB 46.75 | |
| 15U, -PFM, -PGB | 32 x 24 x 16½ | 1[3] | " " | 15 | 39.95; PFM, PFB 54.75 | |

## Heath Co., Benton Harbor, Mich.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| SS-1 | 11½ x 23 x 12 | 2 | Ducted-port bass reflex | 8 | 39.95[4] | prefinished. Also in "Traditional" cabinet at $345 |
| SSB-1 | 29 x 23 x 17½ | 2 | Folded horn | 15 | 99.95[4] | |
| HH-1-C Legato | 41 x 22¾ x 34 | 3 | Modified infinite baffle | 15 (2) | 325.00[6] | |

## Karlson Associates, Brooklyn, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| 12 K | 25½ x 16¾ x 13¼ | 1 | Special coupler | 12 | 42.00 | Can be used in horizontal or vertical position |
| 15 K | 33 x 22½ x 18 | 1 | " " | 15 | 45.00 | |
| 8 K | 17¼ x 11¾ x 9¾ | 1 | " " | 8 | 18.60 | |

## Stephens Manufacturing Co., Culver City, Calif.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| K20 | 29½ x 21 x 14 | 1 or 2 | Folded horn | 12 | 49.00 | |
| K21 | 21 x 29½ x 14 | 1 or 2 | Horn loaded | 12 | 55.00 | |
| K22 | 29½ x 27½ x 18 | 1 or 2 | Folded horn | 12 | 59.00 | |

## Acoustical Development Co. (Acousti-Magic), East Meadow, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| Highboy | 38½ x 23¾ x 22 | 1 | Acoustical labyrinth | 12 or 15 | 54.75[6] | |
| Lowboy | 28½ x 35¾ x 22 | 1 | " | 12 or 15 | 54.75[6] | |

## Argos Products Co. (Californian), Genoa, Ill.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| DSE-1K | 24 x 29 x 15 | 1 | Ultraflex | 12 or 15 | 37.50 | Prefinished: mahogany, blond |
| DSE-2K | 19½ x 23 x 13½ | 1 | " | 8 or 10 | 30.00 | |

## Arkay, 120 Cedar St., New York, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| B-8 | 12 x 24 x 12 | 2 | Ducted bass reflex | 8 | 35.95[7] | |
| B-12 | 17 x 17½ x 15⅛ | 1 | Infinite baffle | 12 | 11.95[8] | |

## University Loudspeakers, Inc., White Plains, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| KEN-12 | 30 x 12½ x 15¾ | 1-3 | Ducted bass reflex | 12 | 39.75 | |
| KEN-15 | 31 x 28 x 19¼ | 1-3 | " | 15 | 49.75 | |

## General Apparatus Co., New York, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| Air Coupler | 72 x 14 x 6 | 1 | Flewelling coupler | 12 | 29.95 | |

## Klipsch Associates, Hope, Ark.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| Shorthorn SK | 36¾ x 24 x 22 | 3 | Folded horn | 12 or 15 | 47.00 | |

## River Edge Sales Corp., Port Washington, N. Y.

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| 110 | 16 x 36 x 16 | 2 | Bass reflex | 12 | 39.50 | |

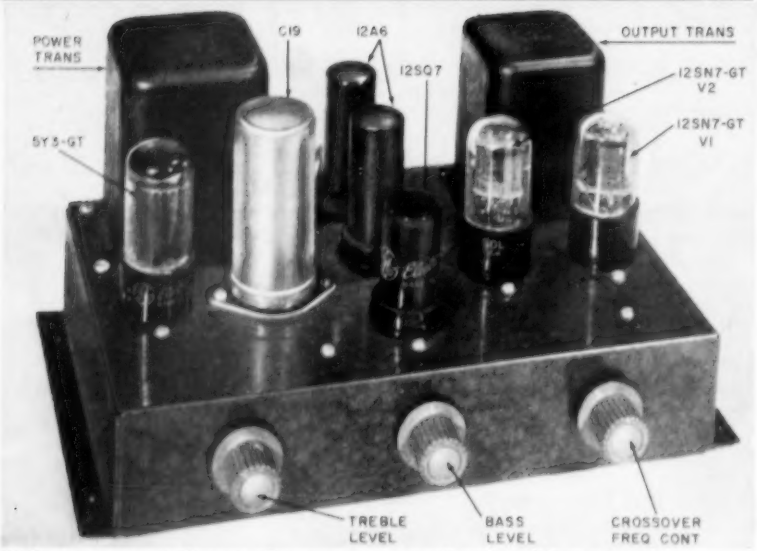
## Sherwood Electronic Labs, Chicago

| Model | Dimensions (in) H W L | No. of Spkrs | Type | Biggest spkr (in) | Price | Remarks |
|---|---|---|---|---|---|---|
| SFK | 31 x 25 x 14¼ | 3 | Folded horn | 12 | 129.00 | Complete with 3 speakers |

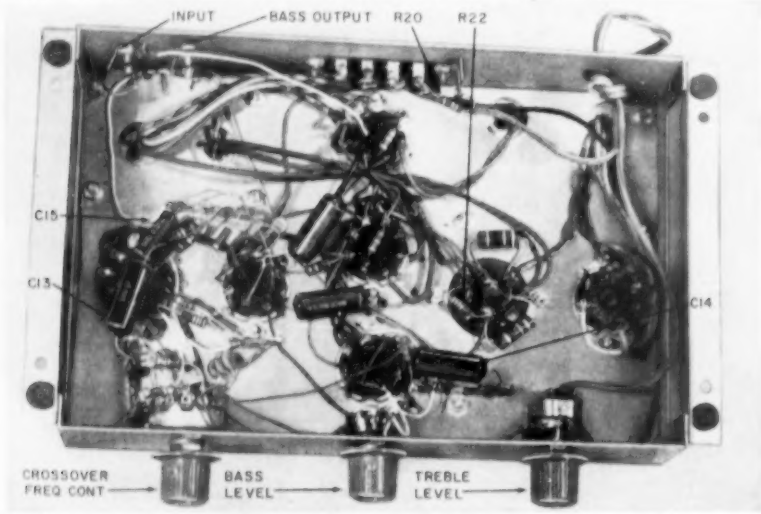
*Add this unit and own a dual-channel hi-fi system*

# an electronic crossover amplifier

by GEORGE L. AUGSPURGER




**Major components layout of crossover network and treble amplifier.**




**Underchassis view of modified amplifier.** *Photos by Terence Sullivan*

THE technique of using separate power amplifiers to feed high- and low-frequency loudspeakers has a number of advantages over the more common dividing networks inserted in low-impedance speaker lines:

1. Since highs and lows are split fairly early in the amplifying chain, intermodulation distortion is reduced.
2. The gain of high- and low-frequency channels can be adjusted independently to compensate for different speaker efficiencies without interfering with output damping.
3. The crossover frequency can be made adjustable at little additional expense.

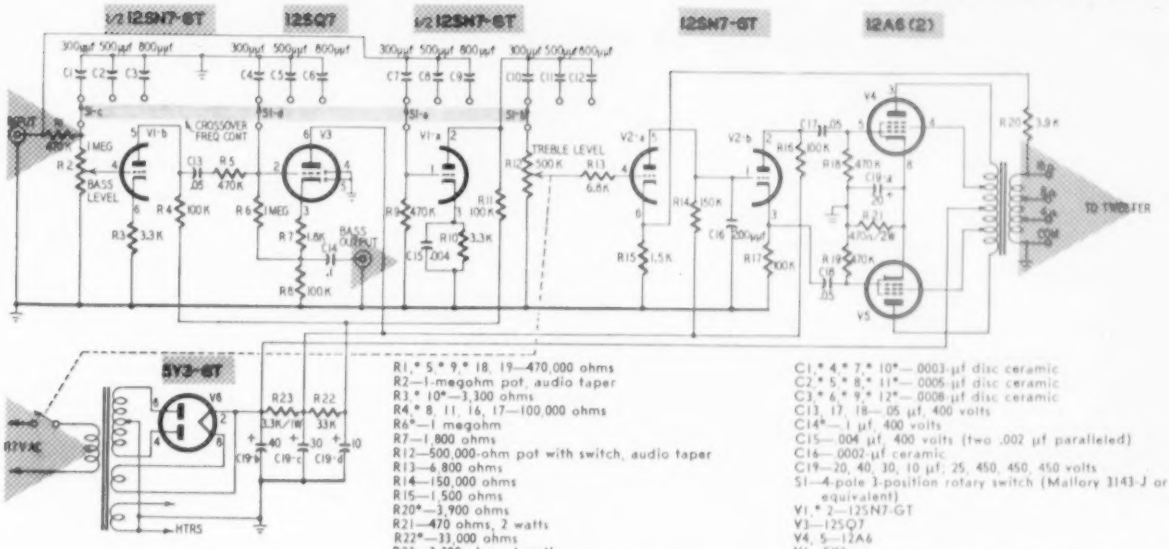
Adding another power amplifier and a high-impedance dividing network to the family music system involves an inevitable cash outlay, but this can be reduced by combining the treble amplifier and crossover network on a single chassis. The photograph shows the Heath A-7D amplifier with an adjustable two-channel circuit added. The cost is $18.65 for the kit plus about $4 for additional components, which compares favorably with $18 to $25 for a 12-db-per-octave speaker-dividing network.

The existing power amplifier of a hi-fi installation is plugged into the bass output jack of the crossover amplifier unit, and the preamplifier or control unit is connected to the input terminal. A tweeter goes to the correct impedance tap of the treble amplifier and the woofer is connected to the original power amplifier output. A crossover frequency which best suits these speakers is selected, and channel gain controls are adjusted to give the most pleasing balance between lows and highs.

The circuit of this modified 7-watt amplifier is shown in Fig. 1. Tone control components have been eliminated, but the power amplifier and voltage supply sections of the original Heathkit are practically unchanged. One additional section of decoupling is introduced by adding a resistor in the B-plus filter network (R22) and the feedback resistor (R20) has been reduced in value from 6,800 to 3,900 ohms. The latter change gives about 4 db additional feedback, with increased damping of the tweeter.

Crossover frequencies of 420, 680 and 1,100 cycles are selected by a four-pole three-position switch. The filter sections give 12-db-per-octave attenuation beyond each channel's cutoff. Measured response curves (Fig. 2) agree closely with calculated performance. The middle crossover point turned out to be 620 instead of 680 cycles but, considering the tolerance of ordinary capacitors and resistors, it's surprising that no greater differences showed up.

Ideally, the point at which the two channels cross should be 3 db down from normal gain. In this circuit the crossover point happens to measure




R1,* 5,* 9,* 18, 19—470,000 ohms
R2—1-megohm pot, audio taper
R3,* 10*—3,300 ohms
R4,* 8, 11, 16, 17—100,000 ohms
R6*—1 megohm
R7—1,800 ohms
R12—500,000-ohm pot with switch, audio taper
R13—6,800 ohms
R14—150,000 ohms
R15—1,500 ohms
R20*—3,900 ohms
R21—470 ohms, 2 watts
R22*—33,000 ohms
R23—3,300 ohms, 1 watt
*Resistors ½ watt unless otherwise noted*

C1,* 4,* 7,* 10*—.0003-µf disc ceramic
C2,* 5,* 8,* 11*—.0005-µf disc ceramic
C3,* 6,* 9,* 12*—.0008-µf disc ceramic
C13, 17, 18—.05 µf, 400 volts
C14*—1 µf, 400 volts
C15—.004 µf, 400 volts (two .002 µf paralleled)
C16—.0002-µf ceramic
C19—20, 40, 30, 10 µf; 25, 450, 450, 450 volts
S1—4-pole 3-position rotary switch (Mallory 3143-J or equivalent)
V1,* 2—12SN7-GT
V3—12SQ7
V4, 5—12A6
V6—5Y3
*Components required in addition to A-7D kit.

**Fig. 1—Schematic of high-impedance dividing network and treble amplifier.**

almost 4 db down, but this deviation is so minute that it has no effect on the functioning of the system.

Since a 12SQ7 is included with the A-7 amplifier, it has been retained as a cathode-follower output for the bass channel. This isn't really necessary since both power amplifiers are located

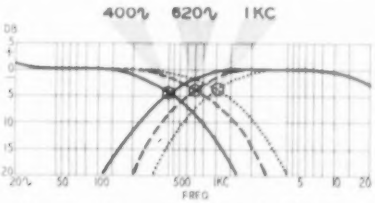



**Fig. 2—Response curves indicating crossover points of network.**

close together in most installations and cable losses consequently pose no problem. In any case, the elimination of high-frequency attenuation in a circuit which amplifies no highs is a little silly, and the cathode follower can be justified only in that it isolates the bass output from the R-C network.

The circuit as it stands may possibly be criticized on two other counts: both grids in the bass channel are run at 1 megohm, which is high enough to make hum pickup a problem; the correspondingly high network impedance of the treble channel results in undesirable high-frequency attenuation because of Miller-effect capacitance between grid and ground. Capacitor C15 is included in the cathode circuit of V1-a to help out the extreme highs, but even so response is down 3 db at 20,000 cycles.

Fortunately, both these drawbacks, plus the questionable utility of the cathode-follower output, can be rescued by shuffling the circuit slightly. The improved version is shown in Fig. 3. Here the impedance of all stages is cut to 50,000 ohms and the cathode follower performs the necessary function of providing a low-impedance source to drive the 50,000-ohm filter sections. With this arrangement the gain from the input to either output will be about unity—the amplification of V2 makes up for the voltage loss in V1. Of course, if your preamp already *has* a cathode-follower output, V1 can be discarded once and for all.

Standard capacitor values change the crossover frequencies slightly in the second circuit. The diagram shows three capacitors in each filter section, .0022, .004 and .0068 µf. With these values crossover frequencies are 1,500, 800 and 500 cycles, respectively. Other frequencies may be used by selecting suitable values from reactance charts or extrapolating from the values shown. For example, .01 µf has a reactance of 47,000 ohms at about 300 cycles. A crossover at 2,500 cycles requires .001-µf capacitors. These values are, all approximate, but the 10% tolerance of standard components plus the uncritical requirements of speakers make closer computation unnecessary.

It may be asked why a full-range push-pull amplifier was used for the high-frequency channel. Articles have recently been published which give the impression that any old thing will do

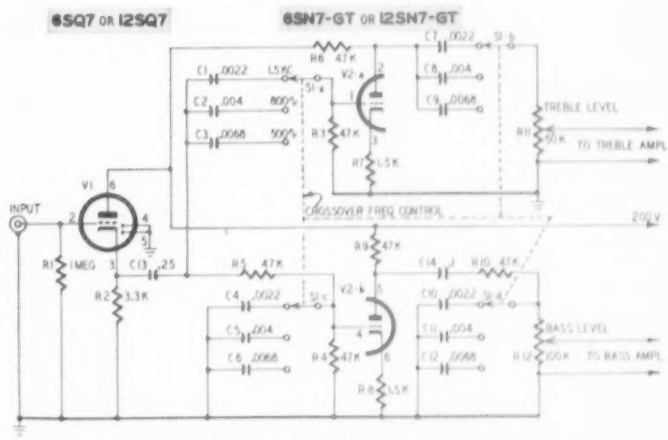



**Fig. 3—Improved high-impedance dividing-network circuit.**

R1—1 megohm
R2—3,300 ohms
R3, 4, 5, 6, 9, 10—47,000 ohms
R7, 8—1,500 ohms
R11—pot, 50,000 ohms, audio taper
R12—pot, 100,000 ohms, audio taper
*Resistors ½ watt unless otherwise noted*
C1, 4, 7, 10—.0022 µf, 600 volts
C2, 5, 8, 11—.004 µf, 600 volts
C3, 6, 9, 12—.0068 µf, 600 volts
C13—0.25 µf, 400 volts
C14—0.1 µf, 400 volts
S1—4-pole 3-position rotary switch (Mallory 3143-J or equivalent)
V1—6SQ7 or 12SQ7
V2—6SN7 or 12SN7

for the highs—a single 6V6, a single 6J5, a 98*e* output transformer. However, it seems logical that the amplifier used for the treble channel must be equal in quality to that used for the bass notes. Getting rid of intermodulation products only to throw in 5 or 10% harmonic distortion is not an equitable exchange.

As to power requirements of the two channels, it is quite true that the *very* high frequencies in music normally generate an infinitesimal power level compared to low frequencies, but the distinction becomes less and less marked as the center of the audio spectrum is approached. For a symphony orchestra, maximum power output occurs at about 300 cycles and is only about 8 db above the peak power at 3,000 cycles.* Therefore, if we want to use a 400-cycle crossover, the power rating of both channels will have to be nearly the same.

With a 1,000-cycle crossover we may assume that peaks in the bass channel will average about 8 db higher than those in the treble amplifier, which corresponds to a power ratio of 6 to 1. Consequently, the A-7 is entirely adequate for use with 30–50-watt bass amplifiers if the crossover frequency is not lower than 800 cycles. Where 300–500-cycle crossover frequencies are indicated, the high-impedance network should be used with a more powerful amplifier such as the Heath W-4AM.

It is possible to keep on adding filter sections and output stages for three- and four-way speaker systems, but this is a little elaborate for any but the most ultrafied installations. A suitable compromise which retains many of the advantages of the dual-channel idea is to drive both treble speakers from the high-frequency amplifier and then insert a suitable filter in the speaker line for the super-tweeter. END

**Frequency Range and Power Considerations in Music Reproduction*, Jensen Technical Monograph No. 3, Jensen Manufacturing Co., pp. 5–6.

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# TOO WELL CHECKED

HERE'S one for the book. A friend brought in a Lafayette model 735 PA system (see diagram) for repair. He said it made a loud popping noise at times. The amplifier uses push-pull 6L6's in the output, preceded by a 7N7 driver, a 7B7 and three 1273's. It has two mike inputs, a phono input and two tone controls. The three channels feed into the bass and treble tone control circuits and then to the 7B7 audio amplifier.

Finding the trouble was easy. A wirewound screen voltage-divider resistor in the output stage was burning up and the resistance wire was unwinding. This accounted for the intermittent condition. I made the necessary repairs and checked for any shorts in the B plus circuit. Everything seemed OK, so I fired up. Tube socket voltages around the 6L6's seemed about right. With the mike and speaker connected, volume seemed OK and the tone controls acted normally. I checked the other two channels and they too checked OK.

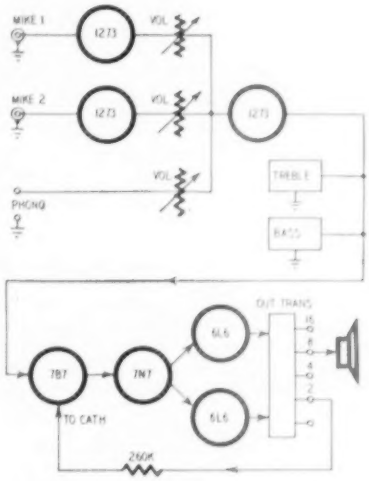
Then I made my mistake. Having a moment to spare, I decided to connect an audio oscillator to the input and check the waveform of the output on my scope. I had not yet advanced either the output control on the audio oscillator or the volume control of the appropriate channel on the amplifier. When I touched the scope probe to the plate terminal of one of the output tubes, I noticed a smeary, large-amplitude trace which looked like a high-frequency oscillation. Using the highest sweep range on the scope and guessing roughly, I figured that the amplifier was oscillating at about 50 kc. This seemed odd indeed, since the amplifier voltages had checked out OK just a minute ago and operation using the mike was normal.

I shut off the power and connected an alligator clip to the plate terminal of one of the 6L6's. Then with the scope probe tucked inside the clip, I had both hands free to work. With the power on, I measured about 15 volts grid-leak bias at each 6L6 grid. No question about it, this bird was really oscillating.

Leaving the alligator clip in place, I removed the scope probe and checked both output grid waveforms, the waveform at the plate of the other 6L6 and the taps on the output transformer terminal board. In each case that same waveform was present. The high-frequency voltage at the 6L6 plate was sufficient to give me an rf burn.

Placing the scope probe back inside the alligator clip at the 6L6 plate, I bridged every filter capacitor and decoupling capacitor, hoping to note some improvement. No dice. Then with my trusty screwdriver, I killed the oscillation by grounding each grid in turn, working back from the output stage. I noticed that back beyond the 7B7 amplifier which feeds the driver, grounding the grid had no effect. I also noted that the feedback loop for the amplifier extended from a tap on the output transformer to the cathode of this stage, and the feedback resistor was unbypassed.

I recalled having seen other amplifiers with a 100-$\mu\mu$f capacitor shunted around this resistor to prevent oscillations at high frequencies where the phase may have been rotated sufficiently to cause regeneration instead of degeneration. Perhaps . . . no, that wasn't




it either. I shifted the feedback resistor from its location at the 2-ohm tap on the output terminal board to each of the other taps, still with no results.

I was able to stop the oscillations by inserting 470,000-ohm resistor in series with the grid of the 7B7 amplifier. Anything smaller would not work. Somehow this didn't seem right.

Then without any real motive, I removed the alligator clip from its location at the 6L6 plate and used it to connect the scope across the speaker voice coil. Lo and behold, no oscillations! Slowly the dawn came. Back went the alligator clip and the scope probe to the 6L6 plate. Noticing that the separation between the 6L6 tube sockets and the apron which mounts the tone controls was only about 1 inch, I slipped a small piece of sheet metal in the separation. The oscillations quit. I could start or stop the oscillations simply by withdrawing or inserting the shield.

Seems that the amplifier was not defective at all, but that by touching the scope probe to the 6L6 plate, sufficient capacitive coupling existed to the tone controls to set the thing off. Even with the alligator clip by itself in place at the 6L6 plate, sufficient coupling existed to sustain oscillations.

The moral . . . sometimes it doesn't pay to get too nosy.—*Monroe Corn* END

# the last link

By NORMAN H. CROWHURST

*An analysis of the physiology involved in hearing*

IN the struggle toward high fidelity we have heard much discussion about equipment, from microphone through amplifier to loudspeaker, the various means of recording and the forms of distortion that all these links in the chain can introduce. Suitable acoustics and enclosure design to reproduce what is claimed as the original sound field has also had its share of discussion. But there is still considerable ignorance about the behavior of the last and most important link in the appreciation of sound reproduction—the link between the ear and the brain.

A considerable amount of work has been done and published on just how the ear transfers sound waves into intelligence to be interpreted by the brain. Most of it has revolved about the behavior of the cochlea, the basilar membrane, the organ of Corti, Reissner's membrane and the hair cells. Do these behave as resonators and just which part corresponds with what frequency received?

Much attention from another angle has been given to subjective analysis of the behavior of the ear. Probably the earliest information at all comprehensive in scope was that of Messrs. Fletcher and Munson who originated the now well known Fletcher–Munson curves and also studied the effect of "masking," the manner in which the intensity of one sound can mask a sound of lesser intensity.

But the last link is really the one that conveys the intelligence received by the ear along the auditory nerve to the brain. Regardless of the manner in which this intelligence is converted by the ear from sound waves to nerve impulses, the fact remains that the last link in the chain consists of a system of impulses conveyed along the auditory nerve.

A common fallacy is the belief that the ear works very much like a microphone, converting the various vibrations constituting sound waves to corresponding electrical impulses for transmission along the auditory nerve to the brain. Thus the "nerve currents" would have a "waveform" like the electrical impulses produced by a microphone.

If this similarity exists, it seems difficult to understand why a musician cannot recognize readily a piece of music by a glance at the soundtrack of a film or the groove on a phonograph disc. The fact remains that even relatively skilled musicians are unable to recognize music in this form. Related questions that arise from this theory are: Since all sounds use a similar spectrum of frequencies, how is it, for example, that by listening to a running motor which generates all kinds of noises, a skilled mechanic is able to locate the particular little tap that to him indicates what is wrong? Or how is it that a musician, listening to an orchestra all of whose instruments reproduce frequencies in the same general spectrum, can locate the sound of one instrument in the whole orchestra?

These questions can be answered by considering how information is relayed from the ear to the brain. I refer to experiments based on the work of Sherrington and Adrian on the electrophysiology of nerves. These experiments show that the nerve impulses carried by the auditory nerve are similar to all other nerve impulses in the human nervous system and consist of a succession of unidirectional pulses transmitted along each nerve fiber.

It appears from a further study of the matter that the auditory nerve consists of between 25,000 and 29,000 ganglion nerve cells and that each of these transmits intelligence concerning one particular frequency in the audible spectrum. The intelligence is transferred in the form of a succession of pulses. However, the pulse rate is related not to frequency or pitch, but to intensity. The threshold of hearing for any particular frequency is the amplitude of sound signal necessary to initiate the first pulse or minimum pulse rate. As intensity is increased, the rate at which pulses are transmitted along that particular nerve fiber is increased.

Any particular sound that we listen to does not arrive at the brain as a synthesis of frequencies or as a specific waveshape corresponding with the pressure waveform of the acoustical wave striking the ear, but rather as a kind of Morse code signal received over a multiconductor cable consisting of between 25,000 and 29,000 nerve fibers. Our recognition of sounds depends on the recognition of the particular pattern received along this multiconductor cable.

Compare this reception of a message by the ear with the reception of the message you are now reading with the eye. You are reading type in a series of familiar forms known as the alphabet. These letters are strung together to form words and the words are arranged to form sentences. Does your brain take time out to realize that the letter o is a circle, the letter l a straight line, e part of a circle with a horizontal

line in it and so on, critically analyzing the geometrical structure of each letter that composes each word? If your brain did, you would spend a considerable number of years reading just this one article. The fact is, the brain recognizes familiar patterns to the extent that it doesn't even bother spelling out the words in detail, but recognizes words as a complete entity and builds up the sentence and the associated thought rapidly.

In a similar manner the brain interprets the sound the ears hear. It is familiarity of the patterns, like familiarity of letters of the alphabet for the eye, that provides the basis for interpretation. When you listen to someone talk, it is familiarity with recognized language sounds that enables you, without the least difficulty, to listen to and interpret what the person says. Also, the shades in a person's voice, which give each individual voice a character distinctive from those of other people, enable you to listen to one particular person speaking among a number of persons talking at once.

This is because the brain can discriminate the difference in patterns received in different ways by using various methods of selection between the complex arrangement of pulses received down the auditory nerve. This can be regarded as somewhat like the manner in which an IBM machine can go through a great many punched cards and pick out just the particular cards, among perhaps millions, that have certain common characteristics. In a similar way the brain can group together impulses representing sounds having any desired common characteristics such as the sounds coming from the same human voice or from the same musical instrument.

Another character of sound that the brain quickly spots is an expected repetition of sound patterns heard. This is what we call reverberation. In any enclosed space there is a slight echo effect following every sound. If you don't believe this try carrying on a conversation in an anechoic completely damped room where there is practically no reverberation whatever. You will quickly realize how unnatural the sounds of voices are under these circumstances. You will then realize that under normal conditions we are always conscious of a reflection, or short-time echo, of all the sounds we listen to. Further, this rapid repetition of all the sound patterns to which we listen is an aid to us in following and interpreting these sounds, whether we are listening to human speech and interpreting the meaning of what is being said to us or to a musical rendition, enjoying its beauty and interpreting what the composer wished to convey to our minds.

There is yet another aspect about this familiarity of auditory patterns which our brains receive. It explains why sounds often heard become more readily accepted than unfamiliar ones. It is "because the ear can believe in them," as one writer has put it, that anything which is recognized can be "believed." Anything unfamiliar requires further listening or analysis for its interpretation. Thus, anything set in the musical scale to which we are accustomed sounds familiar whereas the first time we hear Indian music using a different musical scale, we have the impression of something odd. We may, upon further listening, come to the conclusion that we like or do not like it, but the first reaction is of something unfamiliar and perhaps slightly unreal.

The same is true of synthesized and, to some extent, reproduced sound. It has certain characteristics which are unfamiliar the first time they are heard. At the same time other characteristics of the sound may be familiar because of resemblance to the sounds it is intended to reproduce. Let us illustrate this with the old-fashioned phonograph. Although it reproduces a lot of extraneous sounds not present in the original music by distorting it to a considerable extent, a musician is able by listening to its recorded music to recognize the qualities of the original performance.

Another application of this principle is in the reaction to new kinds of recording—for example, the kind made by Les Paul who has exploited a completely new method of synthesizing sound. The fact that the music rendered is in the pattern of familiar tunes leads the ear into accepting what strikes it first as something unfamiliar about the manner in which the harmony is synthesized into a composite sound. After a few hearings it becomes accepted as a technique in its own right.

Enough has been said, I think, in this short review of the subject to show some of the implications of the principle that what is conveyed from the ear to the brain is not an electrical equivalent of the signal conveyed from a microphone to an amplifier, but a pattern of pulses along the auditory nerve. Here frequencies are identified by the individual nerve fibers excited and the intensity at any instant is identified by the frequency of pulses along that particular fiber. And here whole sound patterns are recognized by the code combination of pulses received along certain combined groups in the auditory nerve.

The reader undoubtedly is capable of pursuing this line of thought in his own mind and will see how this explains many of the things that have been difficult to understand about the character of human hearing.

If interest in the subject warrants it, further articles will be written applying this information to the manner in which we have binaural perception of direction and the importance or otherwise of the various acoustic problems in that reproduction of sound for normal broadcast listening. END

## NEGATIVE FEEDBACK CONTROLS SELECTIVITY

THE HQ-100 Hammarlund communications receiver has an unusual negative feedback circuit as a part of its audio amplifier stages. This circuit provides negative feedback that varies with the setting of the AUDIO GAIN control.

As the control is moved toward its maximum position the feedback voltage, drawn from one side of the secondary of the output transformer through R2, is reduced as it must pass through the increasing resistance of R1 (Fig. 1).

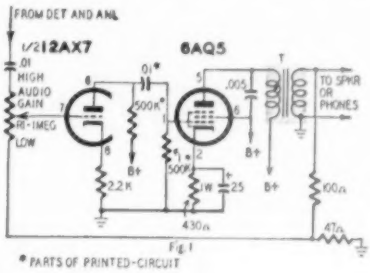


Fig. 1

As this feedback is reduced, the selectivity of the stage increases, resulting in a higher signal-to-noise ratio and permitting reception of weak stations which would otherwise be lost.

When the AUDIO GAIN control is turned down, the feedback voltage rises as R1 presents less resistance to it. This causes a decrease in selectivity and allows a wider range of frequencies to be heard for quality reception of both broadcast and powerful shortwave stations.

Fig. 2 shows two audio response curves. Curve A, the solid line, represents the audio response of the HQ-100 when the gain control is in its maximum

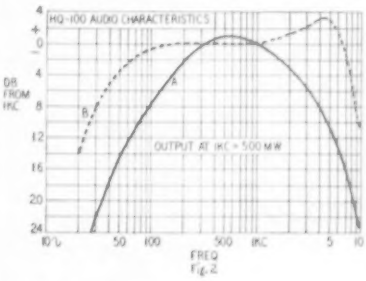
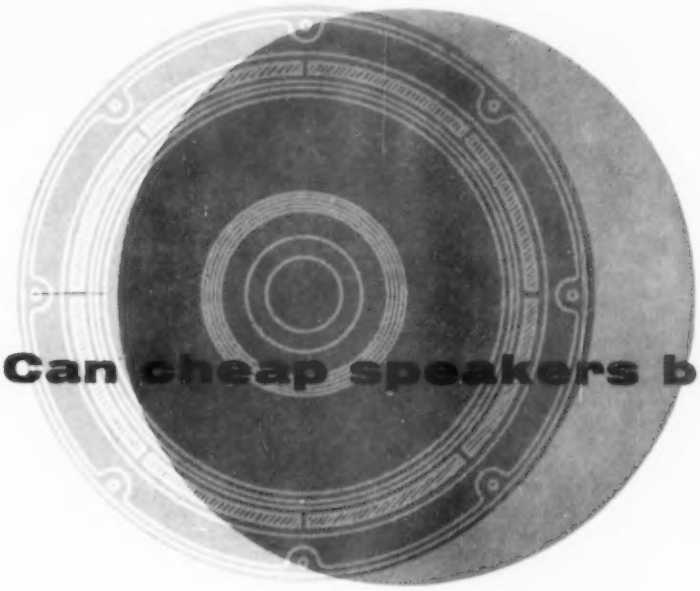


Fig. 2

position. At this setting maximum gain is present at 1,000 cycles. To either side of this point gain drops sharply. For example, at both 100 and 3,000 cycles the signal output is 8 db lower than at 1,000 cycles. This type of response will provide good reception of weak or distant stations and is particularly fine for CW reception.

Response curve B (dashed line) results when the AUDIO GAIN control is set at 25% above its minimum position, approximately what it would be for normal broadcast listening. END



# Can cheap speakers be improved?

*Modification lowers fundamental cone resonance*

By A. L. GEORGE

IN the old days, before audiophiles and high fidelity were even words, a radio service technician had a healthy respect for loudspeakers. The gadget either made a noise or it did not. If it went wrong it was a daring technician who loosened the cemented bits of felt and paper that held the reproducer together. In recent years all this has changed. The hi-fi enthusiast has a number of articles at his disposal which explain some simple method of ripping a speaker to shreds and then substituting scraps of mohair, kitchen utensils and cotton for the original arrangement. The idea is to make a cheap replacement speaker sound like a wide-range triple-cone imported job.

The basic premise behind all these attempts is that the fundamental cone resonance of an expensive high-fidelity speaker is generally considerably lower than that of an economy PA unit. The argument is that, if the home constructor can lower the resonant frequency of the cheaper speaker, it will then perform as well as more costly units. Unfortunately, all sorts of other factors enter into the design of a really good speaker. The reader can pick up a copy of Olson's *Elements of Acoustical Engineering* or Briggs' *Loudspeakers* if he really wants to dig into this stuff. In this article I'll stick to just one important property of loudspeakers: the problem of cone excursions.

Don't ask me why the back-and-forth movements of a speaker cone are called excursions. Probably we could just as well call them jaunts or anything else you like. Excursions is a term left over from classical physics, and we are stuck with it. Anyway, at a given program level the amplitude of the lower frequencies is much greater than that of the treble tones. Consequently the cone excursions of the speaker connected to this signal will become progressively wider as the frequency goes down. This is true until we hit the resonant frequency of the cone. After that the whole system peters out at the rate of 12 db per octave and the cone excursions are relatively minute.

Now then, if we lower the resonant frequency of a speaker by lightening the cone suspension—lessening the restoring force that tends to keep the cone at its zero point—the excursions of the voice coil at this new resonant peak will be much greater than they were at the old one. Here, you see, is the rub! The structural design of the speaker will not allow this increase in cone movement without seriously distorting the signal.

What occurs is not difficult to visualize. Take a look at Fig. 1. The pole pieces of a cheap speaker are pretty shallow to keep the magnetic lines of force as concentrated as possible. This allows a small magnet to be used and still have reasonable efficiency. But in such a system the voice coil doesn't have to move very far to get out of the region of uniform flux density. Once that happens the signal is actually being partially rectified—not a condition especially conducive to good reproduction.

The expensive wide-range speaker uses a big hunk of magnet and spreads the magnetic field so that the voice coil can jump back and forth quite a bit and still have a uniform magnetic force acting on it. In some high-fidelity speakers such as the Hartley, cone excursions in the order of ¼ inch are handled almost disdainfully by the powerful magnet structure.

So if we ignore the more refined

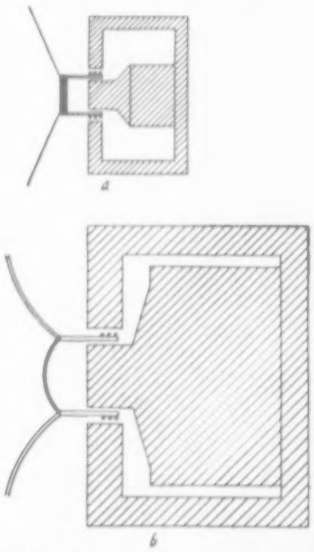



**Fig. 1—Comparative magnet structures; a, inexpensive speaker voice coil and magnet; b, high-quality speaker has larger voice coil, heavier magnet assembly and longer flux gap.**

points of speaker design, the whole thing boils down to the trick of lowering the cone resonance of our bargain speaker without overdriving it. The solution is both elegant and obvious—turn down the volume control. And so here we are: if we increase the compliance of a speaker cone suspension, we lower the resonant peak and extend the bass range of the unit but we seriously limit its power-handling ability. If the modified loudspeaker is to be used as an auxiliary speaker in a quiet location such as a bedroom, the sacrifice in maximum power may not be too serious and the extension of bass response worth the trouble. So let's see how this improvement can be made.

It is best not to get involved with the spider or voice coil suspension, so most everybody sets to work on the outer-cone suspension in this project. It can be sprayed with various kinds of liquid dope. But these dry out eventually and leave the speaker in worse shape than before someone started improving things. You can cut away slots in the rim of the speaker and then stuff the holes with cotton batting as someone suggested. I tried that and it didn't last. After a period of time, the little strips left holding the cone to the frame relaxed and, instead of a restoring force tending to center the speaker, the cone now had two points of equilibrium. Visualize a sort of toggle-switch action and you can understand the reason for the horribly garbled sounds that my "improved" speaker trumpeted forth.

I tried getting rid of the remaining little strips and substituting a chamois ring for the outer-cone suspension (remember the old Stromberg-Carlson soft leather suspension?) but this didn't help much. Apparently there is more to a leather suspension than just gluing a ring of chamois skin to a speaker cone. Although the resonant point dropped almost an octave, the distortion in the bass register increased a corresponding amount and the net result was most unsatisfactory. The appearance of the leather-mounted speaker so intrigued an engineer friend of mine that I gave it to him and the chamois suspension job is now serving as a broadcast monitor in the washroom of station KTYL.

Recently I found a Stromberg-Carlson RC-25 8-inch speaker in my storage chest and the idea of improving it again came to mind. This time I recalled the rubber suspension of the English Lowther PM-2 so I tried a sponge-rubber outer suspension. This idea actually works and so far as I know it is the only such trick which will successfully lower the fundamental resonance of a speaker without introducing a host of undesirable difficulties.

### Improving the speaker

Before you start slicing up a speaker cone, let me point out that since the technique of improvement will reduce the power-handling capacity of your speaker to about one-quarter of its rated value, make sure that you set to work on a fairly sturdy unit. I don't recommend operations on any speaker rated at less than 8 watts or smaller than 8 inches in diameter. Also the spider has to be one of the standard dustproof cambric affairs. If you dig out an ancient Magnavox with a solid Bakelite spider assembly, it simply won't do.

You will need to trot down to the nearest variety store and buy a sponge-rubber ironing board pad and a tube of rubber cement. The sponge rubber supplied for ironing boards is just the right thickness and you'll have plenty left over for use in mounting microphonic preamplifiers and record changers. The only other equipment needed is a pair of scissors and a sharp knife (a small straight-bladed hobby knife is ideal).

The first step is to cut away a series of slots in the cone as shown in Fig. 2 until only eight little strips are left holding the speaker cone to the mounting frame. If you cut away the whole suspension (as I did), you'll have a

**Fig. 2—Eight slots are cut in the outer cone suspension. Slots and remaining strips will be covered by a sponge-rubber suspension ring.**

devil of a time trying to glue the rubber ring in place without getting the cone off center. Then, very carefully slice away enough of the cardboard mounting ring so that it is level with the topmost bump on the speaker cone as in Fig. 3. If you don't get this alignment right, the sponge rubber will pull the cone to a new point of equilibrium and this new point will not center the voice coil in the region of uniform flux density.

Now that the speaker is ready, cut a ring from the sponge rubber to fit your particular speaker. Actually, the rubber ring should be cut about ¼ inch smaller in diameter than its calculated size since it will stretch slightly while mounting. If everything seems to fit, you may now get out your tube of cement, apply a coat to the rubber ring, one to the cardboard mounting ring and a thin line to the cone and glue the parts together. WARNING: Don't stretch the ring too much as you glue it around the perimeter of the speaker. If you overdo it (as I did), you'll wind up with an excess bulge of rubber and no place to put it.

You can spend the few minutes required for the cement to set firmly in trying to get the goop off your hands. This job will take several days, so the sooner you get at it, the better!

Now move the cone up and down to make sure it doesn't scrape anywhere. If it does, you may just be pushing slightly sideways or you may have actually pulled something out of align-

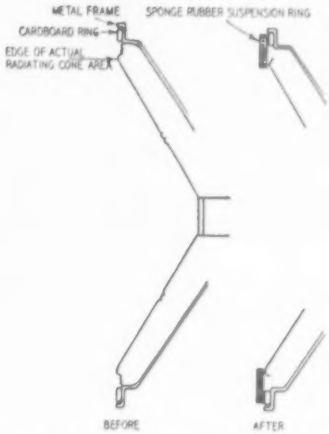



**Fig. 3—Cross-section of typical outer-cone suspension before and after cementing sponge-rubber ring in place.**

ment during the improvement operation. If this last turns out to be the case, well, too bad, but think of all the valuable experience you gained. If all seems to be in order, however, tap the cone and note that the resonant point has dropped about half an octave. Now mount the completed project in a decent baffle and try it. You should easily be able to hear the extended bass response but don't turn the volume up too loud. The reconditioned unit will break up audibly on the bass at only a few watts.

As I mentioned previously, such a loss in power-handling ability is not particularly disadvantageous if the speaker is to be used for low-level listening in reasonably quiet surroundings. As a remote speaker in the bedroom or den, the improvement in frequency range which can be had at a cost of about $6 for the speaker plus another $2 for sponge rubber and cement is worth the trouble. The whole operation is not difficult and takes only about an hour.

(For those of you who have been trying to figure out the extra cone in the center of my converted RC-25, it is just an experimental high-frequency propagator such as is used by Electro-Voice and Goodmans. The idea was first employed by Voigt (see "High-Fidelity Loudspeakers," March, 1954) who says that, if satisfactory results are to be obtained, the diameter and angle of the small cone, construction material and so forth have to be just right. He is perfectly correct. My speaker certainly looks impressive and I notice no deterioration in quality, but the highs are not noticeably improved. Unless you want to experiment, don't bother with the extra "whizzer" cone.) END

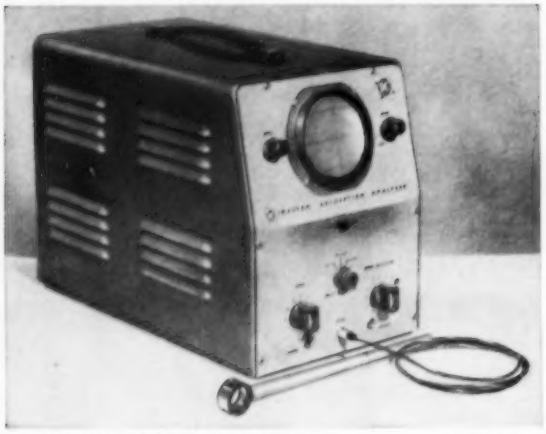
# what's new?

**POCKET-SIZE FM RADIO**, for mobile communications, may point the way to pocket receivers for FM broadcast listeners. Designed by RCA for the 150-mc region, it weighs 10 ounces and is fully transistorized, possibly the first commercial application of transistors on such a high frequency. It is intended to extend existing 150-mc mobile systems. The low transistor drain permits its being kept "turned on" while being carried, thus intercepting all messages. It has its own loudspeaker – is not an earphone rig. Arthur Malcarney of RCA Commercial Products hinted that research and engineering on personalized two-way radio equipment is being carried on, and stated that "unobtrusive, far-ranging pocket receivers and transmitters" will increase the applicability of two-way radio virtually without limit.

**ROBOT BROADCASTER** is invention of Don V. R. Drenner, RADIO-ELECTRONICS author, and engineer at KGGF, Coffeyville, Kans. The device is a sort of signal-searching tape recorder. Forty-five 1-minute spot announcements are recorded on tape, each being allocated an identifying code. When the announcer needs a given commercial or sign-off, he dials the code and the tape recorder goes into high speed, racing either backward or forward till it reaches the beginning of the announcement. Then it drops to playing speed and puts the announcement on the air. At the end of the message the tape stops, unless another code has been fed into it. The human operator need know nothing of tape recorders—operation is strictly pushbutton. The photo shows the back of the tape recorder with additional equipment needed to make it respond to code signals.

**COLOR TV DEMONSTRATION ROOM** is another handy gadget the aggressive color TV dealer may find profitable. Obtainable in two sizes (8 x 12 or 12 x 12 feet) it is framed on metal tubing sections and closed in – walls and ceiling – with Masonite panels and fire-resistant fabric. Spokesmen for RCA, who manufacture the room, point out that with it a customer can view color TV under almost exactly similar conditions to those of his or her own livingroom. The room can be set up by two men in 2 to 3 hours.

**WORLD'S BIGGEST CLOSED-CIRCUIT TV** setup helps passengers get their tickets faster in New York's Penn Station. With 105 Dage TV cameras and 101 14-inch TV receivers, the problem of getting reservations is tremendously simplified. The ticket clerk dials a clerk at the ticket racks in the rear, who places availability boards showing space in the desired train under a camera. The clerk and prospective passenger can then see just what space is available, make a selection and inform the reservation clerk. He in turn takes the required tickets from a file and places them in an Intra-Fax (facsimile) machine which reproduces them for the customer at the counter. Reservations phoned in are handled by a battery of clerks ahead of TV monitors, who inspect the availability boards, check with the would-be passenger and make out the reservations on a telautograph, which is reproduced for the clerk at the reservations window.



Kingston Absorption Analyzer.

# TWO NEW TV TESTERS

By ROBERT F. SCOTT
TECHNICAL EDITOR

*These devices can save you both dollars and time*

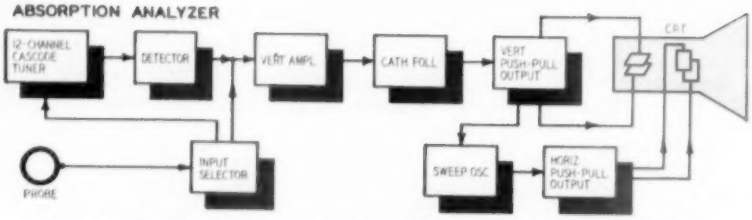



Fig. 1—Functional diagram of the Kingston Absorption Analyzer.

TWO new test instruments of particular interest to TV service technicians have recently appeared on the market. One, the model VS4 Absorption Analyzer, a product of Kingston Electronic Corp., is a special-purpose oscilloscope designed for signal tracing in monochrome and color sets. A set of unique electrostatic ring probes enables the technician to pick up the incoming signal at the set's antenna terminals and trace it through the set from the top of the chassis *without any direct connection to it*. In some sets, pertinent waveforms can be studied and the trouble localized without taking the chassis out of the cabinet. It even lets the technician view waveforms at the plates of the damper and horizontal output tubes without special probes or makeshift gimmicks.

The other instrument is the Pic-Probe, made by the Radionic Division of Raven Electronics Manufacturing Co. This device is a servicing accessory that displays a normal TV picture on the screen of a standard scope so it can be used in place of a set's picture tube or TV test kinescopes like the 8XP4.

## Kingston's VS4 analyzer

As the block diagram (Fig. 1) shows, this analyzer is a special type of scope with a built-in cascode tuner and a video detector. The tuner is a Standard Coil unit with special strips covering the 20- and 40-mc if ranges and 3.58–4.5 mc for checking color-burst and intercarrier sound circuits. The 20-, 40- and 3.58–4.5-mc strips are normally inserted in place of channels 2, 3 and 13. Strips for these channels are supplied and may be substituted for strips of any three unused channels in the service area. The complete schematic of the VS4 is shown in Fig. 2.

The analyzer is generally fed with signals picked up from the plates of the various stages through special electrostatic probes. These probes, consisting of a metal inner conductor, a phenolic insulator and an outer metal shield, are placed over the tube in the circuit being checked. The signal is picked up by capacitive coupling between the inner conductor and the tube's plate, and is fed to the input of the analyzer.

There are three interchangeable electrostatic probe tips. Two are circular as shown in the photo. The larger is for GT type tubes and the smaller for seven- and nine-pin miniatures. The third is semicircular and is used when checking circuits in dual-purpose tubes such as twin triodes and triode-pentodes. These pickup heads fasten to the probe handle and miniature coaxial cable with snap-on connectors.

A direct-pickup type probe, available as an accessory, permits the analyzer to be used as a conventional scope and allows the technician to check rf and if circuits without an external detector probe and, in many cases, without a preamplifier. The direct probe has a built-in step attenuator.

## Circuit analysis

The vertical deflection circuits of the analyzer consist of a 6BK7 cascode vertical amplifier, a 6C4 cathode follower and a 12AT7 push-pull output stage driving the vertical plates of the 3RP1 cathode-ray tube. This circuit has a deflection sensitivity of about 2 mv per inch. When signal tracing in audio circuits, the character of the sound may be heard in phones plugged into the SOUND jack on the panel at the same time that it is being observed on the screen. Gain is controlled by a two-gang potentiometer with one section in the cathode circuit of the 6C4 and the other in the bias circuit supplying the input section of the 6BQ7.

The horizontal sweep oscillator is a cathode-coupled 6J6 multivibrator whose frequency is variable from 20 to 120 cycles when the SWEEP switch is in the V (vertical) position and 4,000 to 40,000 cycles when in the H (horizontal) position. The SWEEP switch changes the range by switching the grid-to-plate coupling capacitors. The SYNC control on the front panel varies the oscillator frequency within the extremes of each range. Oscillator synchronizing voltage is taken from the vertical deflection amplifier through the SYNC AMP control on the rear of the chassis.

The oscillator voltage is fed to a 12AX7 phase inverter and amplifier driving the horizontal deflection plates in push-pull. Width of the trace is controlled by varying the amount of signal applied to the input grid of the 12AX7. The WIDTH control is a screwdriver adjustment on the rear of the chassis.

As mentioned earlier, the turret tuner has special 20-, 40- and 3.58–4.5-mc strips. When the INPUT SELECTOR switch is in the RF–IF or 3.58–4.5-MC positions, the signal picked up by the electrostatic probe is fed to the input terminals of the tuner. Then it is amplified in the cascode rf stage. If the BAND SELECTOR (channel selector on a TV set) is tuned to a TV channel or to the 40- or 3.58–4.5-mc bands, the oscillator beats with the incoming signal to produce a 25-mc signal at the mixer plate. When the BAND SELECTOR is set to 20 MC the oscillator is inoperative and the mixer operates as an amplifier.

The output of the mixer, or 20-mc amplifier, is fed to the input grid of the vertical amplifier through a T type mutual-inductance coupling network

consisting of L1, L2 and L3. C1 and C2 are blocking capacitors. The series arms of the coupling network are the mixer plate coil (L3) and the vertical amplifier grid coil (L1). L1 and L3 are tuned to the mixer output frequency. The shunt leg L2 adjusts the coefficient of coupling between L1 and L3 to produce a 21–27-mc bandpass. This network, like similar ones in the video if circuits of early Du Mont and Television Assembly TV receivers, produces a bandwidth and response curve available only with many more tuned circuits using conventional if tuning elements.

The signal from the T network goes to the grid of the vertical amplifier where it is rectified by grid-leak detection. The signal envelope or video waveform is then passed through the amplifiers to the cathode-ray tube.

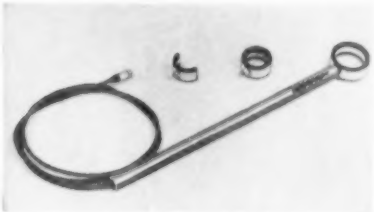
When the INPUT SELECTOR is on DIRECT, the signal is applied directly to the input grid of the vertical amplifier and the output of the tuner is grounded to prevent spurious interferences.

## Radiotronic Pic-Probe

The model 300 Pic-Probe is an amazingly simple accessory that permits an oscilloscope to substitute for a picture tube when servicing a TV set on the bench. It shows such faults as nonlinearity, distortion and pincushioning that would normally appear on the set's picture tube.

The unit (see photos and Fig. 3) has pickup coils in L1 and L2 mounted 90° apart in a ring on the body of the probe. When the probe is pushed into the deflection yoke so the ring is at or near the center, the deflection currents in the horizontal and vertical deflection coils induce voltages in L1 and L2. R1 and R2 are damping resistors and R3–C1 and R4–C2 are integrating networks to convert the induced voltages to sawtooth waveforms. The voltages from R3–C1 and R4–C2 are fed to the scope's vertical and horizontal inputs, respectively, to form a raster.

The Pic-Probe has a picture-tube type base with leads brought out from the grid and cathode connections (pins 2 and 11). When the probe is in use, its base is plugged into the picture-tube socket. The lead from the grid or



Signal tracing probes for the Absorption Analyzer.

Direct probe for the Kingston Absorption Analyzer.

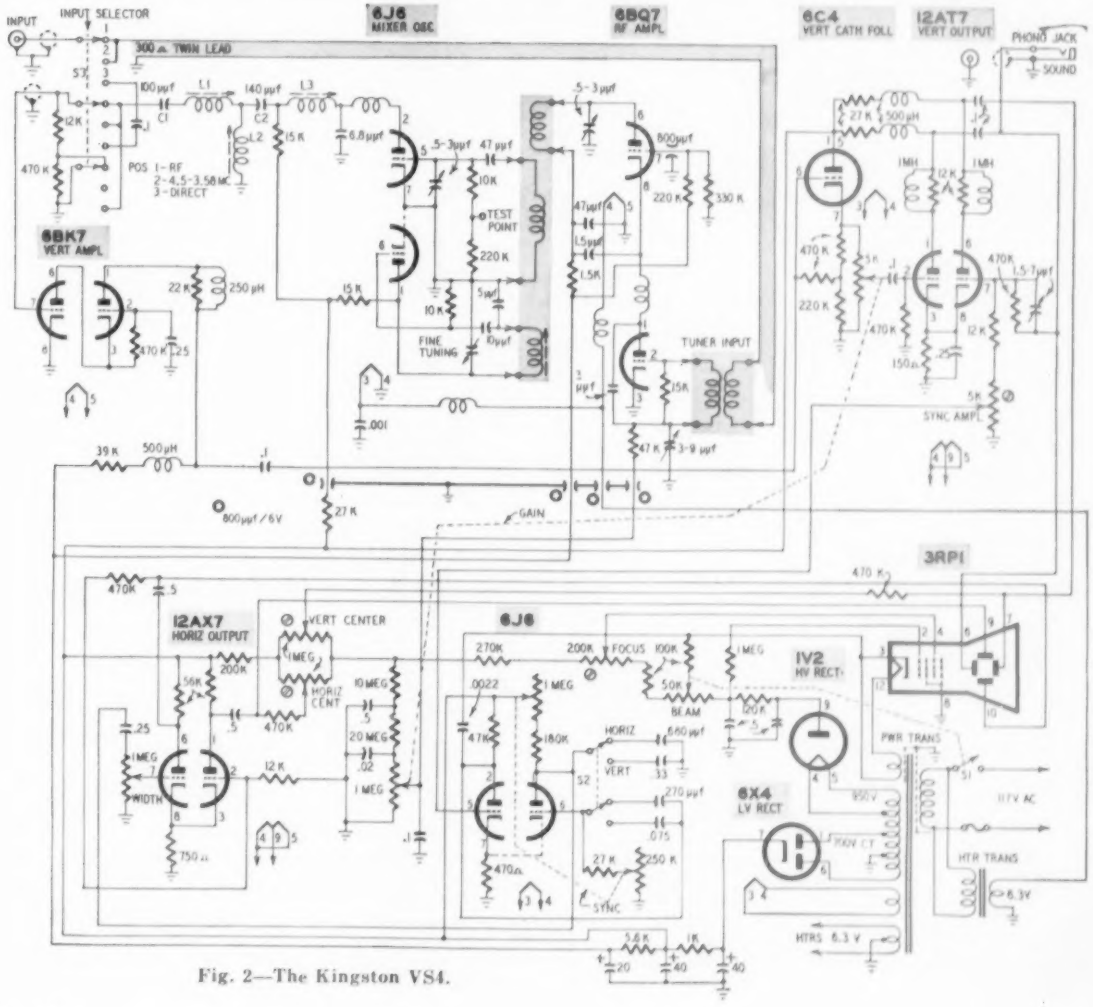
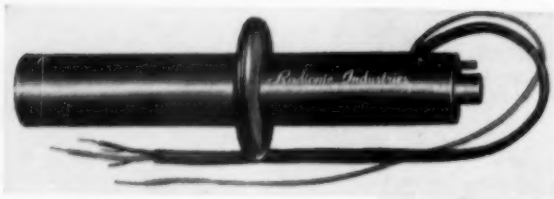



Fig. 2—The Kingston VS4.




The Radionic "Pic-Probe"

The Pic-Probe in Use

cathode pin—depending on the set's video circuitry—is connected to the Z-axis modulation input terminal on the scope. The video signal picked up from the picture-tube socket modulates the

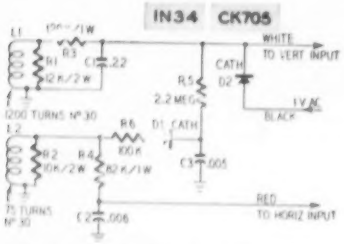



Fig. 3—Circuit of the Radionic Pic-Probe.

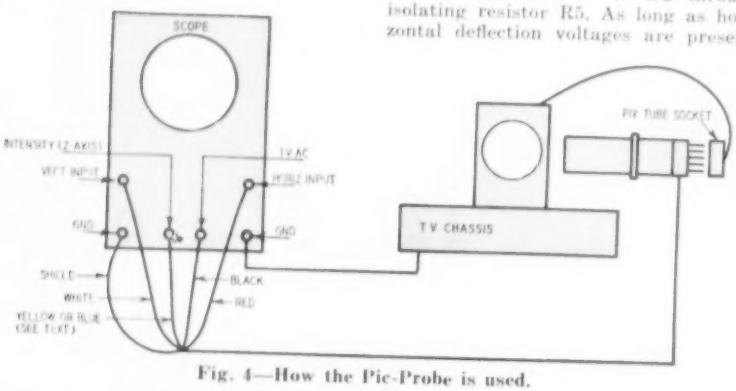



Fig. 4—How the Pic-Probe is used.

beam of the scope's C-R tube and produces a picture just like that normally appearing on the set's picture tube. The setup is shown in Fig. 4.

When the video signal is applied to the cathode of the picture tube, the yellow lead from pin 11 connects to the Z-axis terminal. The blue lead from pin 2 is used with grid-modulated picture tubes. The picture obtained may have either negative or positive polarity, depending on the polarity of the video signal taken from the receiver and on whether the scope uses grid or cathode modulation.

The 1N34 and CK705 diodes D1 and D2 along with R5 form a protective circuit for the screen of the C-R tube in the scope. This is necessary because when the set is turned off or the probe is withdrawn from the yoke, the beam is not deflected and the intense spot of light may burn the screen.

D1 rectifies a portion of the horizontal sweep voltage induced in L2 to develop a positive voltage that is applied to the cathode of D2 through isolating resistor R5. As long as horizontal deflection voltages are present, the back bias on D2 prevents it from conducting and passing the 60-cycle ac signal to the vertical input of the scope.

In the absence of a horizontal deflection current in the yoke, D2 conducts and enough 60-cycle signal is applied to the scope to deflect the beam vertically and prevent it from burning the screen.

The 1-volt signal for the protective network can be taken from a calibrating-voltage terminal on some scopes or from a voltage divider connected across a grounded 6.3-volt supply as in Fig. 5. The protective circuit can be

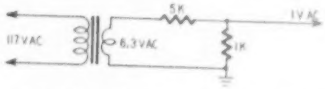



Fig. 5—Network to protect cathode-ray tube.

omitted but the technician must remember to turn down the intensity control or switch the scope to internal sweep each time the TV set is turned off or the Pic-Probe is removed from the deflection yoke. END

In the JUNE issue of

**Radio-Electronics**

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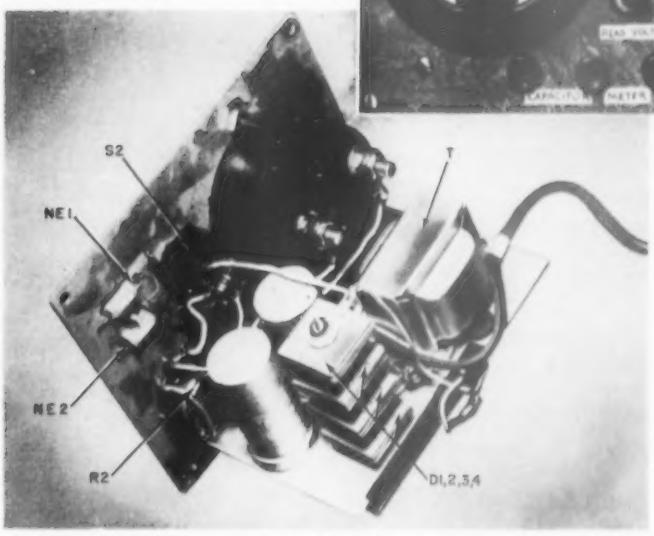
# CAPACITOR CHECKER

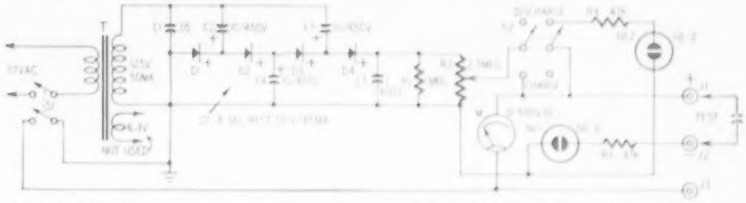
By JOSEPH COZZO

*Tests capacitors under their normal operating voltage*

Panel.




**Layout of major components. Neon bulbs seen through panel slots.**




R1—1 megohm, ½ watt
R2—2.5 megohms, potentiometer
R3, 4—47,000 ohms, ½ watt
C1—.05 µf, 600 volts
C2, 3—10-10 µf, 450-450 volts, electrolytic
C4—10 µf, 450 volts, electrolytic
C5—1 µf, 600 volts
D1, 2, 3, 4—selenium rectifiers, 65 ma, 130 volts
T—half-wave power transformer, 125 volts, 50 ma
S1—dpst switch
S2—dpdt switch
NE1, NE2—neon lamps NE-2
M—voltmeter, 0-500 volts
Pin jacks (3)
Cabinet and chassis

**Schematic diagram of the capacitor checker. Unit under test is connected to jacks J1 and J2 and is checked under actual operating conditions.**

AMONG the most difficult parts to test in electronic equipment are paper, mica and electrolytic capacitors. A common way to test electrolytics is to use an ohmmeter and note the charge and discharge. The results are sometimes misleading and are of little value since many electrolytics on the verge of total failure will show a good kick. Paper and mica capacitors are even more difficult to check because they give little or no indication.

Here is a checker which tests capacitors under actual operating voltages and gives a visual indication of leakage, shorts and opens. Simple to build and operate, it is a versatile instrument which will save many hours in searching for obscure faults.

The capacitor under test is inserted into J1 and J2 (see diagram), correct polarity being observed. If in a set, lift the hot end and connect with clip leads. The proper polarizing voltage is selected by R2. When S2 is thrown to CHARGE, the capacitor, if not open, charges, and leakage is indicated in NE1 which flashes intermittently, depending on the capacitor's condition. If the capacitor is shorted, NE1 glows brightly. Should there be no leakage, the capacitor may be open. Now throw S2 to DISCHARGE. If capacitor is good, it will discharge through NE1 and NE2.

S1 opens the ground lead of the voltmeter when the power is turned off. Thus it can be used independently by using J1 and J3 to read voltage. Were the voltmeter put across J1 and J2, its relatively low internal resistance would shunt the jacks and NE1 would glow continuously. J1 and J3, with S2 on charge, can also be used as a source of metered variable dc for other projects.

Micas and ceramics of low values will not show leakage if good, but will show discharge. Larger values will show leakage as well as discharge. Paper and oil units will show leakage and discharge. An excellent capacitor will not leak and the greater the rate of leakage, as shown by NE1 flashes, the poorer it is. Electrolytics, because of their low internal resistance, charge up slowly and then pass current, causing NE1 to glow. Upon discharge, the neons glow with falling intensity and the voltage reading drops slowly. If the electrolytic is shorted there is no discharge, and the neons do not glow. Upon charge the voltage rises immediately and on discharge falls immediately. An open capacitor does not flash either neon lamp. This is a positive test, in which a short cannot be confused with high capacitance, nor an open with low capacitance.

The checker is mounted in a utility cabinet, 6 x 5 x 4 inches, with a subchassis. The layout is not critical, and one is as good as another. The neon lamps are mounted back of the panel and held by small clamps with viewing slots cut in the panel. Note that C2 and C3 are floating, while C4 and C5 are grounded. R1 is a bleeder. If the seleniums get hot, a 100-ohm resistor may be put in the lead going to each anode. END

*Simple instrument brings half-a-dozen new operations within the range of your scope*

By RICHARD GRAHAM

# a SCOPE SWITCH

THE Scope Switch is one of the simplest and most useful accessories you can construct and use with your oscilloscope. While this is one device that uses no tubes or transistors, don't let its simplicity fool you. The variety of ways it can help you around the lab or shop is impressive.

For example, have you ever observed a complex waveform with a dc component such as encountered in TV work and wanted to know where the zero dc voltage reference was in relation to the waveform? Or perhaps as a ham working on vhf or uhf or at low power, have you wondered how really to measure percentage modulation? Have you ever wanted to measure a very small dc voltage but didn't have a meter that could read in the millivolts? Perhaps you've wanted an oscilloscope calibrator? And undoubtedly there have been occasions where an electronic switch would have been handy? Well, the Scope Switch will—with an oscilloscope—perform all of these things and more.

## The chopper

Basically the Scope Switch (Fig. 1) is a mechanical switch hooked up with a choice of three circuits which are selected by a "function switch." The actual heart of the instrument is a device known as a chopper. This chopper is an electrically driven mechanical switch. It consists of a driver coil, a reed and a pair of contacts on each side of the reed. The construction vaguely resembles an autovibrator but should not in any way be confused with it. The chopper is a precision piece of equipment and as such is not cheap. The contact in the chopper specified is a gold alloy with a very low contact resistance which remains low with use. The contacts are rated at 0–1.5 volts dc, 1 ma. However, short-time overloads will do little harm. The chopper is designed so that very little time is lost in switching between contacts. This very efficient switching action produces an excellent square wave which can be put to a variety of uses. Even the fact that some small amount of time is lost in switching can be put to good use as a pulse generator. More on this later.

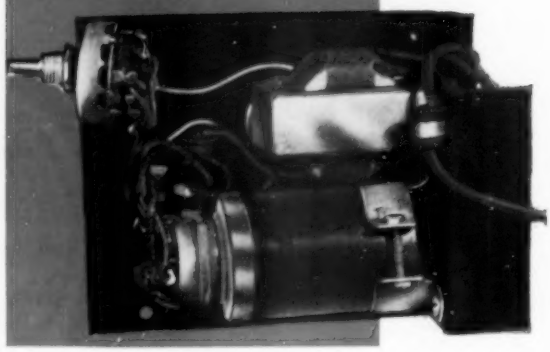
The time it takes for the reed to pass between the two contacts can be measured quite easily by the circuit shown in Fig. 1. This circuit is also basically the same as that when the function switch is in position A, Fig. 2. In this circuit the two contacts of the chopper are connected in parallel and are in series with a battery which is applied to the input of an oscilloscope. The time the reed is between the two contacts can be observed as a short spike or pulse on the oscilloscope. This pulse occurs at a 120-cycle rate since the battery voltage is interrupted twice during the chopper driving frequency of 60 cycles per second.

Therefore the pulse is

$$\frac{.0625}{2} \times \frac{.00833}{1} = .00026 \text{ second}$$

This pulse is available at the output jacks when the function switch is in the A position. The pulse serves as an excellent timing mark for calibrating the oscilloscope sweep frequency and for measuring other pulse widths. By setting the Scope Switch control GAIN B to maximum and putting a capacitor in series with INPUT B and the signal to be observed, these timing marks or pulses will appear superimposed on the waveform under observation. Since the pulse frequency is known, simply counting the number of cycles between the pulses and multiplying by 120 gives the unknown frequency. This is further illustrated in Fig. 3 in which four cycles are counted between the two timing pulses. The unknown frequency would then be 4 × 120 or 480 cycles.

The Scope Switch can also be used as a 60-cycle square-wave generator.



**Few components are needed in this versatile instrument.**

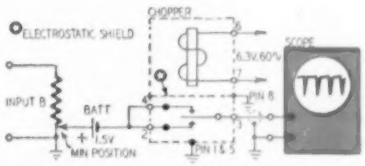



**Fig. 2—The A function position, basic circuit.**

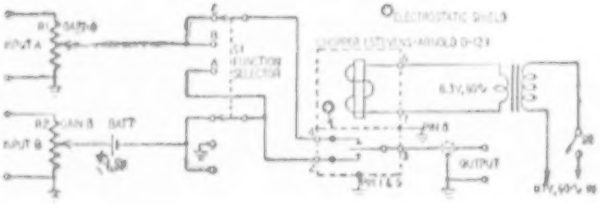



**Fig. 1—The Scope Switch complete circuit.**

BATT—1 5-volt penlight cell
S1—Double-pole 3-position rotary switch
S2—Spst toggle switch
R1, 2—100,000-ohm pots
T—6.3-volt 2-amp transformer
CHOPPER—Dc-ac chopper, type D-12 (Stevens-Arnold Co., 22 Elkins St., South Boston, Mass., or equivalent)
3 x 4 x 5-inch box

The basic circuit for this operation is shown in Fig. 4. This is the circuit when the function switch is in position C. A battery is in series with one of the contacts to ground, thus a scope at the output jacks will reproduce a 60-cycle square wave. The squareness of this wave form is attested to by the fact that its harmonics are plainly

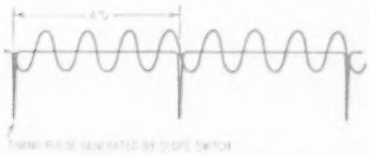


**Fig. 3—Timing pulses generated by the Scope Switch.**

heard when a broadcast receiver is hooked up to the output jacks. This amounts to hearing beyond the 20,000th harmonic of 60 cycles! This illustrates one more use for this position — that of signal source for servicing broadcast sets. Simply by feeding the square-wave output through a capacitor (to avoid possible damage to the chopper if placed in the wrong part of the circuit), the square-wave output can be fed into any rf, if or af stage. A 60-cycle buzz should be heard if all is functioning properly from that stage on in the receiver.

Another useful job for the square-wave setup is as an oscilloscope calibrator. The amplitude of the square wave generated by the switch is equal to the battery voltage if GAIN B control is set at minimum. The battery voltage is fairly constant throughout its shelf

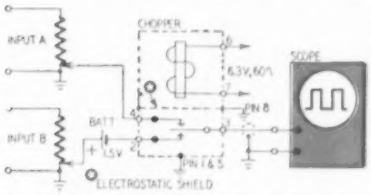



**Fig. 4—Basic circuit for the C function.**

life. Thus, setting the gain of the oscilloscope for a square-wave amplitude of (for example) one box on the screen means that 10 boxes would equal 15 volts. Of course any scale and proportion suitable to the measurement on hand can be used. This voltage-calibrating function is particularly handy in calibrating the scope for waveform analysis in TV servicing and similar work.

Another important use of the Scope Switch in the C function position is as a mechanical switch to view two waveforms of the scope simultaneously. A 1.5-volt cell is series with one of the contacts is used to displace the two patterns on the scope face. If it is desired to superimpose the two patterns, simply eliminate the battery.

Since the switching rate is fixed at the line frequency of 60 cycles per second, the sweep frequency of the scope must be set at some fractional multiple of 60 cycles to avoid having the scope sweep oscillator lock in at the switching frequency. The square waves generated by the Scope Switch will then slip by the sweep frequency of the scope, which is synchronized to the two input signals being observed. The rise time of the square wave is so short (as discussed previously) that it is not seen. This gives the appearance of two straight lines on the scope onto which may be added two signals through the two inputs A and B.

Some juggling of the scope sweep frequency may be necessary to find the sweep frequency that happens to be an exact multiple of both signals put into the inputs and which is also a fractional mulitple of 60 cycles. For example, if it is desired to view a 15-cycle signal at INPUT A and a 50-cycle one at INPUT B, 150 cycles would be the lowest oscilloscope sweep frequency that could synchronize with both input signals and that is not an exact multiple of 60 cycles.

Very often in analyzing and observing more complex and unsymetrical waveforms such as those encountered in TV, we need to know where the zero

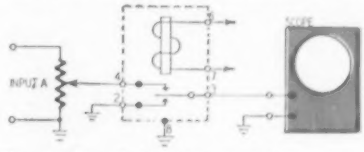



**Fig. 5—The B function position.**

dc reference line is in relation to the peak or some particular part of the waveform. In the usual ac-coupled oscilloscope, if a waveform has a dc component (as most unsymmetrical waveforms have), the zero dc reference cannot be observed. The obvious solution is to use a direct-coupled scope — but unfortunately these are not available to most of us. By using the Scope Switch with an ordinary ac scope, the zero dc reference can be seen. The instrument is set in the B function position. The basic circuit of this position is shown in Fig. 5. In this circuit, the signal under observation is fed into INPUT A and one of the chopper contacts is grounded. Thus any dc component of the waveform fed to INPUT A will displace the whole waveform as shown in Fig. 6. The straight line which appears when the scope input is shorted by the chopper is the zero dc reference.

**Fig. 6—Waveform showing zero dc reference, as established by the chopper.**

An interesting application of the Scope Switch when set up in the B function position is measuring percentage of modulation when working with low or even flea-powered transmitters or when working at uhf and vhf. At these frequencies and power levels it is difficult to use the scope to measure modulation percentages by the familiar trapezoid method. The difficulty is that

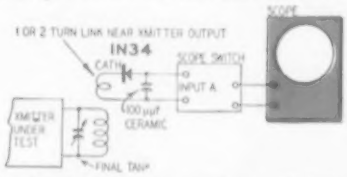



**Fig. 7—Setup for measuring modulation percentage of a transmitter.**

there simply is not enough rf voltage to drive the oscilloscope deflection plates directly.

By using the method shown in Fig. 7, the full oscilloscope gain can be utilized. A steady audio tone is applied to the modulator input of the transmitter under test. The resulting pattern will look like Fig. 8. The trough and crest of the waveform are measured and substituted in the following:

$$\text{Modulation } \% = \frac{A - B}{A + B} \times 100$$

One precaution to observe is that the crystal detector is not overloaded with too much rf. This can be determined by varying the coupling into the crystal detector. The output waveshape should not change. The scope gain must be readjusted accordingly to make up for the change in coupling.

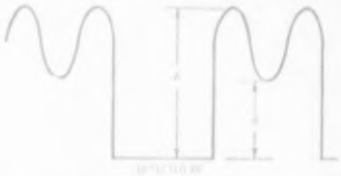
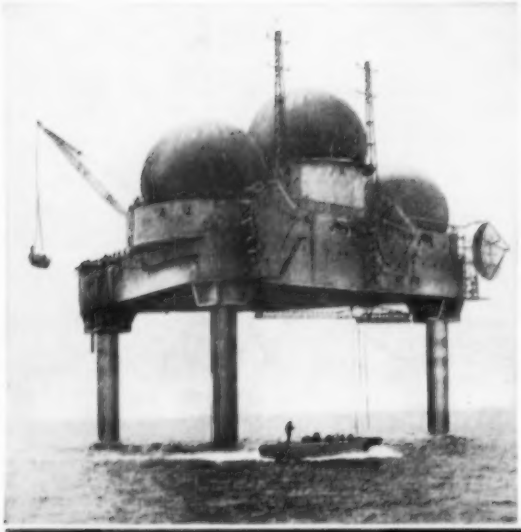


**Fig. 8—Scope waveform for measuring modulation percentage.**

Another use for the B function position is to measure small dc voltages. By applying a small but unknown dc voltage into INPUT A and by turning GAIN A to maximum, the dc will be changed to an ac signal which can be measured on the scope. Very small voltages can be measured, the smallness being limited largely by the maximum gain of the scope used.

The Scope Switch is constructed in a 3 x 4 x 5-inch box and is quite straightforward. The chopper—which is really meant to mount in an octal socket—is held to the chassis by a clamp, with the plug end up. This was done to give short leads between the function switch and the chopper. Short leads are desirable to minimize capacitance leakage through inputs A and B on the Scope Switch. The photographs illustrate the constructional details for those wishing to follow the original layout. Actually nothing in the construction can be classed as critical and the builder may follow his own ideas so long as the length of the leads is kept reasonably short. END

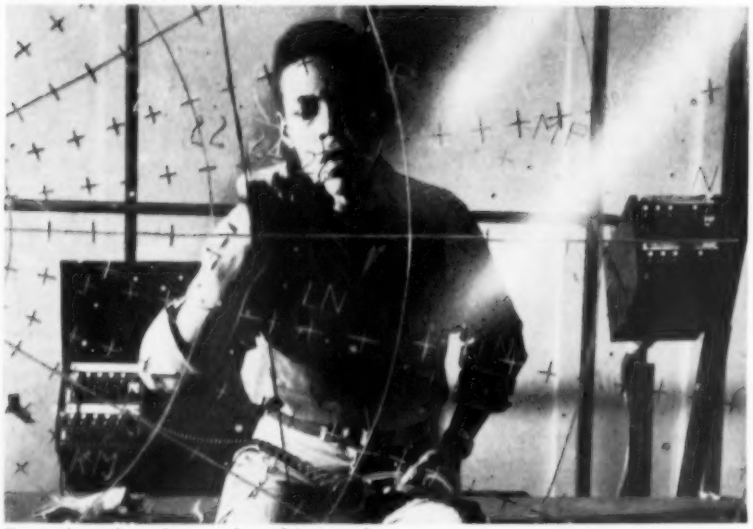


# Electronic TEXAS

By COL. NELSON S. BROOKS*

"Going aboard" the tower is an exciting but safe business. Masts are for radio communications; parabolas for tower-to-shore telephone service.

Engaged in the tower's main business—scanning the scopes for signs of aircraft.



Oncoming aircraft are plotted in regular style on a transparent plastic board.

FOR the past year passengers of air and sea transportation off the northeast coast of the United States have been curiously aware of a strange triangular-shaped configuration looming abruptly above the surface of the Atlantic Ocean about 100 miles east of Cape Cod, Mass. Huge bulbous radomes inflated on top of the structure and large parabolic antennas on the shoreward side indicate its purpose to the initiated. This is a "Texas Tower," or off-shore radar station, recently admitted as a new member of the air defense team. For almost a year this tower has been an integral part of the Continental Air Defense system and, in conjunction with radar picket ships and airborne early-warning aircraft, provides radar air surveillance to seaward far beyond that which can be provided by shore-based radar stations alone. Aboard the tower, 70 officers and men of the U.S. Air Force maintain 24-hour daily vigil at radar scopes to detect and report any unidentified air activity off our eastern coast.

By early 1954, it had become apparent that the advent of the high-speed jet bomber would make necessary an extension of the aircraft early-warning network to seaward to provide the additional warning necessary to alert the civilian populace of an impending air raid and to place fighter aircraft of the U.S. Continental Air Defense Command in a favorable position to intercept and counter such a threat. The urgency of the situation was clearly recognized and design of the first "Texas Tower" began immediately. At that time it was decided to pattern the platform after those used for off-shore oil-drilling operations in the Gulf of Mexico, commonly referred to as "Texas Towers." That name has remained with the ocean radar platforms of the Air Defense Command.

By May, 1955, the 6,000-ton, $10,000,000 steel platform had been constructed and launched at the Bethlehem Shipbuilding Co. yard at Quincy, Mass., and soon thereafter was towed out to position at Georges Shoal on the Continental Shelf. Under 55 feet of water, the legs were firmly imbedded 46 feet in the sand of the shoal and the tower was jacked up until the bottom of the platform was 67 feet above the mean water level of the ocean.

With the tower in place, the Air Force began the installation of communications and electronics equipment.

*Hq Eastern Air Defense Force, Stewart Air Force Base, Newburgh, N.Y.

# TOWERS

## Guard Our Coasts

In May, 1956, the tower was ready.

Texas Tower No. 2, as the installation is known, is a monument to modern technology as an engineering, constructional and electronics accomplishment. The most modern equipment in the Air Force inventory is utilized on the tower, including one of the first military operational applications of point-to-point tropospheric-scatter communication techniques. On this three-tiered triangular platform is found every communications and electronics system and device required to operate a modern radar station. Search and height-finding radar equipments, hf and uhf radio, telephone intercommunicating systems, a dial telephone system, an extensive public-address and paging system, an aircraft radio navigational aid and an integrated wire–radio system to shore providing multi-channel service on a single uhf radio carrier, comprise a portion of the varied electronics equipment installed.

Texas Tower No. 2 is the first of several such installations programmed for construction off the east coast of the United States from Nova Scotia to Virginia. The second tower was launched in August 1956, towed to position, jacked up and technical equipment is now being installed. Each of these towers will provide radar air surveillance over its assigned area to seaward, reporting all unidentified aircraft observed to a shore-based air defense direction center, which will in turn scramble fighter aircraft to perform the intercept. As the much publicized SAGE (Semi-Automatic Ground Environment) Air Defense System becomes operational, these towers will become a part of that system.

The most interesting communications facility aboard the tower is the point-to-point tropospheric radio circuit. The development of tropo-scatter techniques has been closely observed by both the military and commercial interests since 1949 when the National Bureau of Standards began a large-scale research program in that direction. This interest in forward-scatter communications has been considerably influenced by the economic advantage of providing reliable wide-band transmission service over long distances without the use of intermediate relay stations. The military is also interested in this type of service since it is not affected by atmospheric disturbances normally found in arctic regions. Uhf signals scattered in the troposphere have been found to provide reliable service well over 200 miles, while ionosphere-scatter vhf signals are reliable over path lengths of 600–1,200 miles. For those interested in the technical details of tropo-scatter techniques, the October, 1955, *Proceedings of IRE* are devoted entirely to the background, development and technical considerations influencing this significant contribution to the art of communications. The National Bureau of Standards has also published considerable information in its January, 1956, *Technical News Bulletin*, based on five years of experimental and theoretical investigation by the Central Radio Propagation Laboratory, and RADIO-ELECTRONICS discussed the possibility of world-wide television based on scatter propagation in its September, 1956, issue.

The tropo-scatter system installed aboard the tower provides a reliable multichannel circuit between the tower and shore. These channels are multiplexed by frequency division on a 10-kw carrier. Reliability is added to the system by simultaneous emission from two transmitters at each terminal, both transmitters operating on the same frequency. Three 28-foot parabolic antennas are installed. By diplexing two of these antennas, each is used simultaneously for both transmitting and receiving. The third antenna is used for receiving only, thereby giving triple space diversity reception.

The scatter circuit is introduced into telephone systems at each end. The shore end is interconnected with the Bell Telephone System for the remainder of the circuit length, and the tower radio termination enters the tactical and administrative telephone systems. Using this integrated wire–radio service, a reliable full duplex telephone circuit of good quality has been established between the offices of the Texas Tower commander and the commander of the Air Defense Command at Colorado Springs, Colo.

A dial switchboard is installed on the tower for nontactical usage in an effort to conserve people and living space. Since a manual switchboard might have required an additional 4 or 5 persons as switchboard operators, a 100-line unattended dial system was installed. Two selected telephone instruments on the tower are capable of overriding any other call. This insures that the commander or operations officer can instantaneously contact any other telephone on the tower regardless of whether that instrument is in use or not.

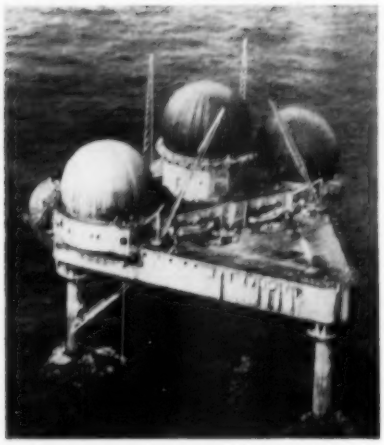
Audio amplifiers are installed for public-address and paging service throughout the tower. These amplifiers excite 8-inch 10-watt speakers in all interior areas, each speaker being supplied with a limiting volume control which can be used to decrease the audio level but not to the point where it is completely inaudible. In mechanical and outer deck areas, weatherproof metal speakers are utilized. The tower is divided into four zones for PA purposes with paging or music distributed to any one or more zones individually or all four zones simultaneously. Provisions are also made for any dial telephone instrument on the tower, or a switchboard operator ashore, to dial into the PA system on the tower.

Radar search and height-finding equipment is installed in the top deck, with their antennas on top of the tower enclosed by three radomes. These 2,000-pound 55-foot radomes, which are visible for miles from the tower, protect the antennas from wind, rain, snow or ice. They are semispherical in shape and sealed to the antenna tower platform. Manufactured from a nonmagnetic, neoprene-coated fabric, this balloon type dome is inflated with air by a high-speed blower, with internal pressure maintained automatically by sensitive pressure switches. If the radome becomes deflated through damage, the antenna rotation is stopped automatically. The radome is de-iced either by radiation from banks of infra-red lamps which melt the ice or by decreasing the internal air pressure of the radome which in turn flexes the fabric and disengages the ice.

High-frequency transmitters (400-watt, 4-channel) are available for emergency communications with the shore and are used to communicate with picket ships and airborne early-warning aircraft. MARS and amateur radio activities are also conducted. A low-power low-frequency radio homing beacon is installed and operated upon request to serve as a navigation aid to helicopter flights en route to the tower.

Power for the tower is provided by diesel generators capable of supplying 1,300 kw. This power is distributed throughout the tower by two systems, a base bus for general lighting and power, and a technical bus for all communications and electronics equipment. Additionally, emergency generators supply an emergency power distribution system.

The exterior walls of the tower are illuminated by floodlights to make the structure readily visible to sea traffic,



**Deck of Texas Tower No. 2. The two cranes raise and lower supplies and men.**

and three searchlights are provided for loading, unloading, search or rescue. Flush decklights are installed for illumination of the heliport.

Duties performed aboard the tower differ but little from those performed at any other Air Defense Command radar station. All aircraft flying in the area must be detected and kept under surveillance; all unidentified tracks must be reported to other designated agencies in accordance with standard procedures and all fighters scrambled and turned over to the tower for control must be directed to the point of intercept. Communications and electronic equipment must be maintained at peak efficiency at all times and power must be generated. Additionally, there are a myriad of administrative and housekeeping duties.

Although life aboard the tower is extremely confined, every attempt has been made to make this duty as attractive and pleasant as possible. Tours of duty aboard the tower are divided into periods of 30 days on the tower and 15 days ashore, with overseas credit given for this duty. Considerable effort has been made to provide the maximum comfort possible for personnel while on this lonely station. Quarters are bright and cheerful. Recreation equipment of all types is available, with moving pictures, radio and television for the entertainment of those not on duty. Although in an extreme fringe area for television reception, Boston stations can usually be received with fair to good quality. There is a completely equipped dispensary, regular mail service provided by helicopter and a well stocked rotating library. Chaplains visit the tower at regular and frequent intervals for the spiritual welfare of those assigned. Helicopters make routine flights between the shore and the Texas Tower, transporting personnel, dry cargo and all priority shipments. Fuel, oil and water are delivered by surface transportation. END

# Electronic Crossword Puzzle

By CHARLES HENRY, GM3HLD

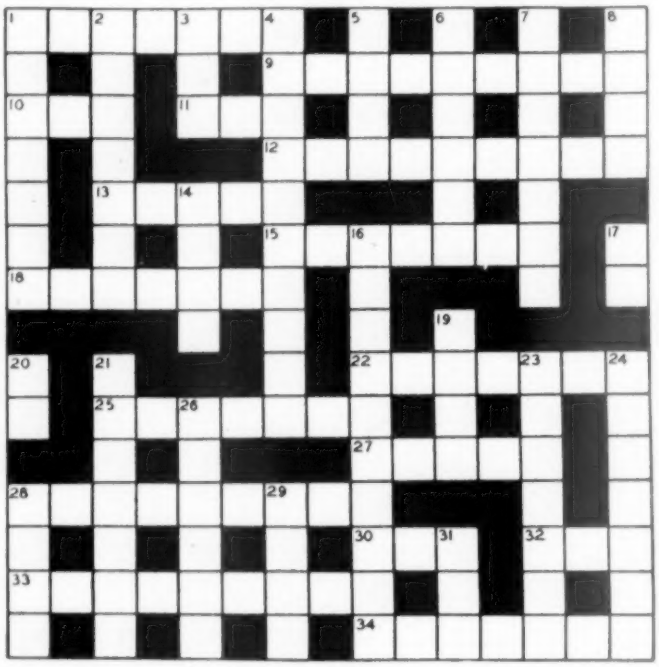
**ACROSS**

1. To know what's going on in circuits, they should be —.
9. An electrical terminal.
10. Annoying Indians from Tennessee vales.
11. One step below u.h.f.
12. If the ratio between the frequencies applied to the scope is constant, then you should see this type of figure.
13. A "pleasant" occupation for a Sunday afternoon, but you'll surely harm the tube if you give it too much.
15. No class-A nor class-B type of amplifier—it's somewhere in between.
18. Ten across is inclined to do this.
22. This effect might give you dx on 11 across.
25. A 6AB4 is one of this type. (If read backward plus 20 down.)
27. It takes a ship into port.
28. An 807 is listed as being able to 30 watts.
30. 0.707 is a very mean square.
32. It is advisable to—a tube before putting it to regular use in a v.f.v.m.
33. When transmitting follow the correct —.
34. Some tubes have them but not to keep out flies.

**DOWN**

1. Z source = Z line = Z load.
2. Tubes with only one obstacle in the electron path.
3. Use a stroboscope to check this preacher.
4. Voltage on either X or Y plates is responsible.
5. Used to safeguard circuits—but oh the spelling!!
6. Waifs of the radio world.
7. Take the "OA" out of a vessel and you have this receiver fault.
8. Millions of ohms.
14. Increases flux linkage but then you get hysteresis.
16. A basic law deals with volts, ohms — —.
17. From (ham language).
19. You need a modulator to communicate in this manner.
20. See 25 across.
21. Blemish on heavenly body known to radio.
23. Remove the cause of 4 down and the beam will—.
24. Belonging to scientist who made waves stand in a wire (disreputable-sounding measuring device).
26. An eggbeater? . . . Yes, but you would probably use a triode-hexode or a pentagrid.
28. One kind of meter does this when you resonate it.
29. A radioman may be— but try using one to fasten a component.
31. This ratio doesn't sit around.

*(See page 130 for answers)*



**Coming Next Month**

An Easily Built Synchronized Subcarrier Signal Generator

Home-Constructed Automatic Shutoff for Your Record Player

# 30-MC transistor Superregen

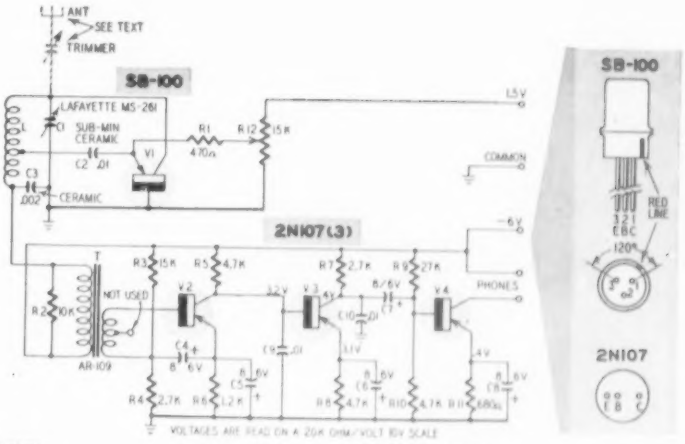
*This high-frequency receiver covers the 9–28 mc range easily, and can be pushed beyond 40 mc in some cases*

By EDWIN BOHR

IF you are interested in a 30-mc transistorized receiver, you can build it now. The transistor is ready to invade another domain previously dominated by the vacuum tube. In evidence, we offer this four-transistor superregenerative receiver that covers 9–28 mc (see schematic). With suitable coils, it will operate at lower frequencies. By pruning the coil a little, it will tune past 30 mc. Transistor operation at these frequencies is still considered a bit unusual. Yet this is a practical circuit any reader can build and operate. It is perfectly straightforward and in many respects resembles the familiar and traditional vacuum-tube circuits.

The only available high-frequency transistors at this time are the Philco surface-barrier types. These are made by a unique process that electrolytically drills cavities on opposite faces of a germanium wafer and then plates the emitter and collector electrodes inside these cavities. Transistors of this type can oscillate easily to 30 mc and some units push the upper limit to over 60 mc. While most high-frequency transistors require high collector voltages, the SB types operate with only low to moderate collector voltages.

Although SB transistors are not too widely known, the most familiar type is the SB-100. In limited production for several years, it has only recently been made available to the general public. It is the type that makes our superregenerative high-frequency receiver possible.




R1—470 ohms
R2—10,000 ohms
R3—15,000 ohms
R4, 7—2,700 ohms
R5, 8, 10—4,700 ohms
R6—1,200 ohms
R9—27,000 ohms
R12—pot, 15,000 ohms, miniature
*All resistors ½ watt*
C1—Miniature tuning capacitor (Lafayette Radio MS-261 or equivalent)
C2—.01-µf subminiature square ceramic (Lafayette C-612 or equivalent)
C3—.002-µf ceramic
C4, 5, 6, 7, 8—8-µf 6-volt electrolytic
C9, 10—.01-µf paper (Aerovox P-81-Z)
L—16 turns, tap at 5 turns. (B & W type 3003 Miniductor)
T—10,000 ohms to 2,000 ohms, center tap not used (Argonne AR-109)
V1—SB-100
V2, 3, 4—2N107
Chassis
Terminal board
Knobs
Miscellaneous hardware

**Four-transistor superregenerative circuit includes detector and three audio stages.**

## The detector

Basically, the detector is a grounded-base oscillator circuit with feedback to the transistor emitter. Appropriately chosen values of C2, C3 and the emitter bias allow the circuit to superregenerate. For best operation, the emitter is tapped across about one-third of coil L. Otherwise, for straight oscillator service, this tap would normally be at a point about one-fifth the total turns with correspondingly less feedback.

As you probably know, a superregenerative receiver is allowed to oscillate but the oscillations are interrupted at an ultrasonic rate. In this condition, incoming signals advance the initial oscillation buildup and cause the average collector current to follow the modulating amplitude and frequency exactly. Quality is reasonably good.

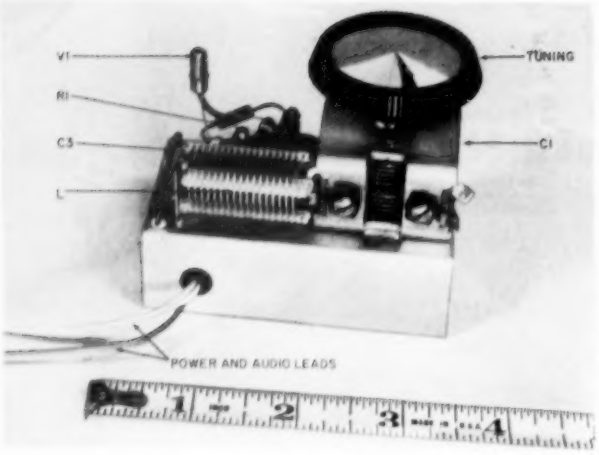
This detecting action results in a very high sensitivity from a single stage, but recoverable audio output is relatively low. For this reason, we use three stages of audio amplification. This gives sufficient gain to drive headphones or a small speaker.

In operation, the tuned-circuit oscillations are rectified by the SB-100 emitter and charge C2 with a negative polarity. This voltage builds up until it is high enough to bias the SB-100 to cutoff, and oscillations cease. The charge then leaks through R1 until the oscillator is again able to commence oscillating and the cycle begins again. The frequency of these interruptions is largely dictated by the vigor of the oscillator, the positive emitter bias and the value of C2. For this reason a relatively large value of capacitance (.01 µf) is used for C2.

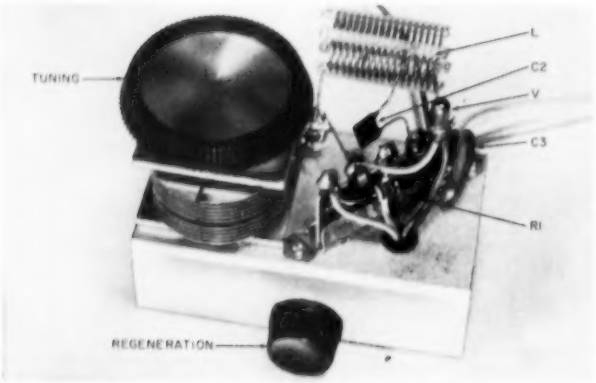
The superregeneration control varies the positive bias level to the SB-100 emitter. Transformer coupling allows the collector voltage to remain constant, despite variations in collector current. If resistance coupling were used instead, the dc collector voltage would vary in direct relation to the emitter current and cause an adverse amount of mistuning with changes in the value of R12.

A 10,000-ohm resistor R2 across the primary of the coupling transformer seems to smooth the action of the superregeneration control and generally improve operation and reduce distortion. This resistor dampens resonances of C3 and T.

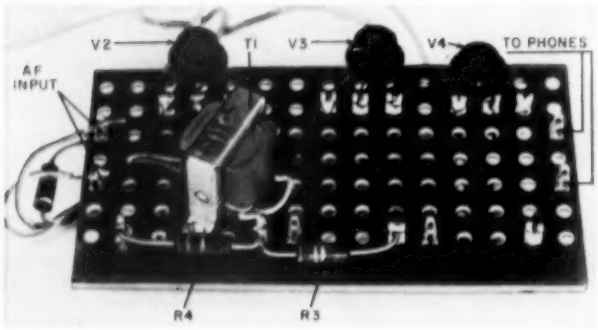
Bias for the detector is supplied by a separate 1.5-volt battery. This eliminates any need for returning the SB-100 base to a voltage-divider and capacitor arrangement which invariably



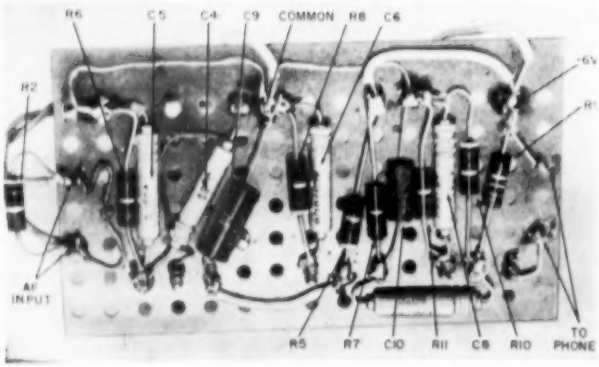

Top rear view of the high-frequency receiver.




Transistorized receiver as seen from the front.




Top of terminal board, indicating suggested component layout.




Bottom view of terminal board.

degrades the superregenerative action. Admittedly, the extra battery is a disadvantage and we intend to perform some experiments using silicon diodes as a low-resistance bias source for this circuit.

## Audio amplifier

The audio amplifier is a straightforward well-stabilized unit. Capacitors C9 and C10 have been added to suppress the very strong quench frequency that might otherwise overdrive the audio stages. The audio transistors are the 2N107 type that now sell for less than a dollar. These usually have a beta gain of from 12 to 20. If higher-beta transistors are used, there may be excess gain and a volume control will be necessary.

Measured voltages are given for the audio transistors. These voltages, outside a tolerance of ±25%, can be changed by varying the values of the emitter resistors. Notice that varying R6 changes the voltage of the V2 emitter and base, and also the emitter and collector voltages of V3. Changing R8 varies only the collector voltage of V3. However, the inherent stabilization in this circuit should make such experimentation unnecessary.

The value of R11 is correct for 2,000-ohm earphones. Cut this value in half for 1,000-ohm phones or double it for 4,000-ohm units.

## Construction

As the pictures show, we built the detector and audio amplifier as separate units. This was to facilitate changes in the detector and subsequent experiments with operation to 60 mc.

Tuning capacitor C1 is a two-gang superhet unit (Lafayette MS-261) that we had on hand. One section of the capacitor is 78.2 $\mu\mu$f and the other is 123.1 $\mu\mu$f. These two sections were tied in parallel. We use the trimmer capacitors for fine tuning, though this is a little crude. If you wish, a 15-$\mu\mu$f variable may be placed in parallel with the MS-261 for expanded tuning. This will make the equipment much more convenient to use, and will aid greatly in tuning in distant stations.

We have found that B&W Miniductor coils give much higher-Q operation than coils wound on permeability-tuned forms. For this reason we use 16 turns or one-half of a stock Barker & Williamson type 3003 Miniductor for L1. (Actually, the photographs show we used 17 turns, but we suggest you cut the coil into two equal parts. This will not appreciably change the tuning range.) The feedback tap is made 5 turns from the T1 end of the coil.

Capacitor C3 should return as directly as possible to the base of the SB-100 transistor V1. Also, resistor R1 must be connected as near as possible to the emitter of V1.

Observe that the full collector voltage appears across tuning capacitor C1. Shorting this capacitor is not advisable. We recommend that you place a .001-$\mu$f

mica capacitor in series from the transistor collector to the stationary plates of the capacitor. This will remove the collector supply from the tuning capacitor plates.

You may have noticed a maximum collector rating for the SB-100 of 4.5 volts. This is for grounded-emitter operation. Since we are using the grounded-base configuration, the collector voltage can be pushed to 6. However, *do not exceed 6 volts!* The emitter and collector leads inside the SB-100 are so small they are hardly visible and make excellent fuses. Any careless or thoughtless overloads, though lasting only milliseconds, could burn out these leads. So be careful. And, above all, *do not connect the collector battery backward!*

The audio amplifier is assembled on a terminal card. This way we put the entire amplifier together from scratch in about 2 hours.

As the diagram shows, we have not used decoupling or bypassing of the collector supply. For this reason, you may find that some batteries cause the amplifier to squeal. To cure this, connect a 100- to 250-$\mu$f 6-volt electrolytic across the 6-volt battery.

## Operation

First, connect a short antenna (say 15 to 20 feet long) to the emitter tap of L1 or through a trimmer capacitor to either the tap or collector end of L1. Too much antenna coupling or loading will not permit the circuit to superregenerate. For this reason, long antennas will definitely need a series-adjustable trimmer.

Now, adjust the regeneration control R12 until a loud frying or sizzling sound is heard. Then, rotate the tuning capacitor until a signal is heard and readjust both the regeneration and tuning controls for best reception.

Because of the broad tuning of the superregenerator, background stations of equal strength may be heard. However, a small rotation of the dial may pass over more stations than you can count, making a fine or vernier tuning control a real advantage.

You may be surprised to see that the circuit oscillates even with the tuning capacitor completely open and that regeneration will not vary too much from one end of the dial to the other. These things, of course, indicate the really hot performance of the SB-100. In fact, you can probably reduce the number of turns on the coil and push operation past 40 mc. We feel that most readers will want to try this.

Another noticeable feature is the detector's stability. If the antenna is not subject to swaying, it will operate for hours without readjustment of the regeneration control. Hand-capacitance effects are not very noticeable.

We feel this article will spark a lot of new interest in high-frequency transistor activity. You can see the SB-100 is suitable for very-low-power transmitter operation too. END

# MISLEADING HEATER STRING

By V. F. WOYCHOSKI

THE radio was common stuff—the usual ac–dc setup—a Canadian RCA Little Master in this case, though the make isn't important. It could happen to any ac–dc circuit.

"It lights up, but won't play," was the complaint. "Had the tubes tested and they're all good."

I hooked it up. Yes, the pilot came to life, the two glass tubes glowed, it hummed normally. There was lots of B plus, but no music.

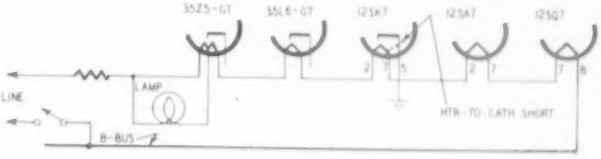
I began to signal-trace. Output stage was fine right back to the 12SQ7 plate side of the coupling capacitor. When the signal was applied to its grid, no soap.

Ahah! The stage is dead. Open or short in something there. Checked the tube myself. Fine. Didn't trust the tester so tried a new SQ7. No good. No visible shorts or breaks, capacitors and resistors fine. B plus OK at the tube socket, OK on the plate prong, too. Other prongs to socket contacts fine. Didn't bother about the heater. What for? Everything glows nicely, doesn't it?

Tried a third SQ7—nothing doing. This is impossible, I thought. The stage is dead and yet there's nothing visibly wrong!

Time to get scientific. It bothered me to have to go to all the trouble of examining a heater string that, to all appearances, was holding its own. Well, would you? But I had to work on something. Decided to test all the tubes again—all came up to par. I'll trust the tester this time. It didn't goof on me on the 12SQ7, did it? Still no music, though, so I went to work checking the nicely glowing heater string, if only for laughs.

The 12SQ7 was at ground end (see diagram). Its pin 8 checked OK to ground. I pulled the tube. Its pin 7 checked OK to ground, too. What? That shouldn't be! I examined the lead between pin 7 on the 12SQ7 socket and pin 7 on the 12SA7. OK for shorts. Worked around the SA7, pulled it, and still got the same story—its pin 2 read to ground. Examined the wiring up to and around the 12SK7. Pulled the SK7 and the offending short to ground vanished. I took the ohmmeter to the tube and there it was, a 100% heater-to-cathode short and the cathode is at ground potential in this circuit.




Looked sideways at the tube tester. Maybe I should trade it in after all. Reached for a new 12SK7. Pilot lamp came to life, the two glass tubes glowed, and—music!

Some credit is due here to our tube manufacturers, or at least to their departments responsible for tube heaters. Either that or I should complain to our power company for low line voltages since only three tubes and the filament dropping resistor carried the full line voltage. An extra 25 volts was divided among them while the other two had none. No wonder the 12SQ7 stage was dead. So was the 12SA7, for that matter, and real, cold dead! END

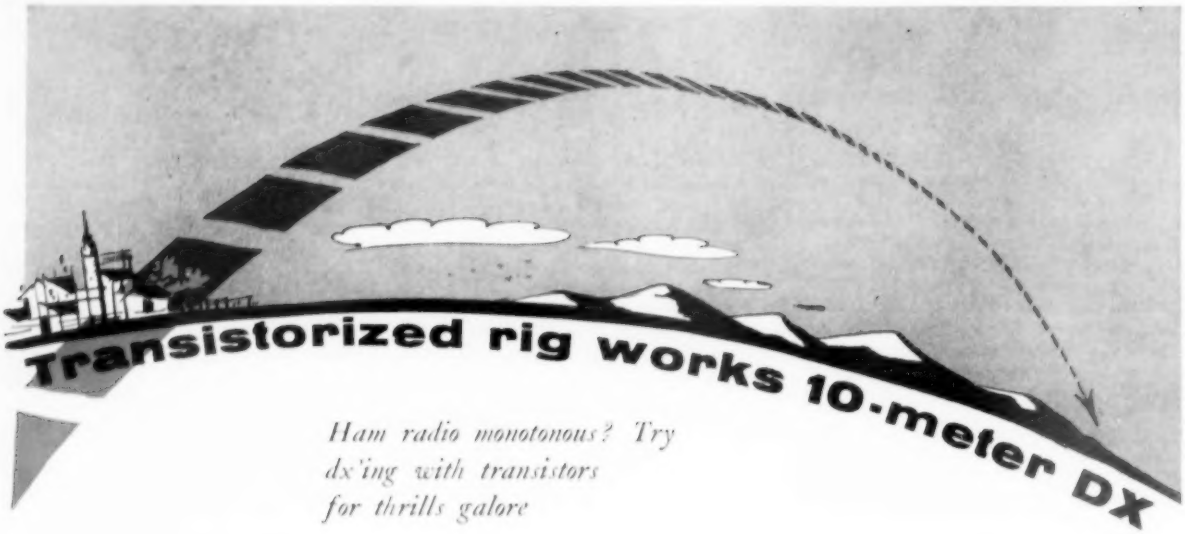
coming... in next month's issue...

AN EASILY BUILT SYNCHRONIZED SUBCARRIER SIGNAL GENERATOR

This instrument uses only eight tubes to produce a 10-volt output at 3.58 mc, synchronized with the horizontal sweep. A necessity for color TV servicing.

HOME-CONSTRUCTED AUTOMATIC SHUTOFF FOR YOUR RECORD PLAYER

Don't take a chance on ruining a valuable stylus! It can happen if the player is accidentally left running overnight. This shutoff requires little labor and only a few standard components.



# Transistorized rig works 10-meter DX

*Ham radio monotonous? Try dx'ing with transistors for thrills galore*

By RICHARD S. GRIFFITH, W7MPQ

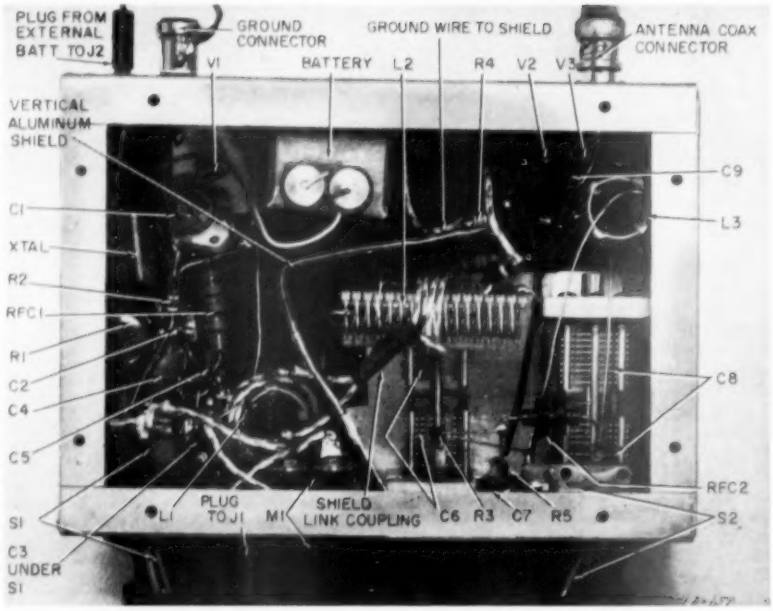
MANY amateur radio operators and experimenters apparently believe that increased distance in communications requires increased power. Here is a transmitter which seems to reverse that idea.

Most components used in transistorized circuits are very small and light in weight. This includes the power source—usually small batteries. I wanted a very small amateur transmitter to use in my small car, a Volkswagen sedan, and decided transistors would solve the problem. The mobile transmitter with transistors is still in the future, but my present low-power transmitter gives some promise of a successful mobile unit using transistors.

The transmitter shown in the accompanying schematic diagram has been used for successful communications with 98 amateur stations in 20 states, 3 in Hawaii and 1 on Canton Island in the South Pacific. The greatest distance for a transmission is 4,500 miles, with 24-mw input to the final amplifier.

My first experiment with a transmitter using transistors was a 160-meter oscillator, but I did not put it on the air. The next was a 40-meter oscillator using a tetrode transistor and, after successful communication over a distance of 1 mile, I went on to 10 meters since that was my goal.

The first oscillator was the same as shown in the diagram except that R2 was added in later rigs to insure immediate oscillation. Without this resistor, oscillation would not start if the transistor was cold. I used to warm it between my thumb and finger to start oscillation. Using V1 alone as a transmitter, I made my first transmission by CW and voice to W7ZSE operating 10-meter mobile here in Tucson. The frequency used was 29 mc, and the distance was 100 yards. But it was a start!




**Top view of the rig. Link windings on L1 and L2 are adjusted for optimum performance.**

That first two-way transistor contact was on May 15, 1956, and was encouraging. It's a good thing that I did not visit a fortune teller or have any other means of knowing the future—I might have given up.

Transistors are funny little beasts but they really can do a good job if they are handled right. One of the difficulties when working with them is to avoid comparisons with tube circuits and characteristics. Another obstacle is the friend who too often reminds you that there are many good tube circuits using low power. That's true, but I'm not so sure they will work out 4,500 miles with only 24 milliwatts input as my transistors have done.

## Operating technique

Most of my contacts have resulted from going on the air with the big rig, a Viking II, and asking a fellow-ham to listen for the transistorized rig on the same frequency. The cooperating amateur then zeroed his receiver on the Viking II. That made it easy for the receiving amateur but it was hard on transistors. Since both transmitters were tuned as closely as possible to the

same frequency it appeared that rf from the Viking II went into the final transistor (we were using a Philco L-5108 in the final amplifier), and after a dozen or so tests the transistor was ruined.

After the second instance of this kind we learned our lesson. Now we ground the final amplifier. Merely disconnecting the antenna lead is not enough.

Out-of-state contacts were all made at the home of O. J. McIntosh, W7RTT, in Tucson, using his Telrex 3-element 10-meter beam antenna. Three of the stations have been worked "solid" by phone and all others on CW.

On Oct. 21, 1956, the first out-of-state contact was made with KφCEM in Bismarck, N. D. A little later that day we worked with W7OEB in Puyallup, Wash., 1,200 miles from Tucson.

The following Sunday we worked KφAWC in Kirkwood, Mo.; W9YZE in Alton, Ill., and W8TQY in Toledo, Ohio, 1,660 miles. Those first five out-of-state transmissions were made with the present oscillator and with the single L-5108 transistor in a final amplifier. The best signal strength report was S3 from W7OEB.

The next out-of-state contact was made with new L-5108 transistors in the push-pull amplifier in the diagram. We had successful communications with 13 stations in 7 states, ranging from Washington to Georgia. The best signal strength report was S7 from W4KKG near Louisville, Ky., on Nov. 18. At this writing 102 amateurs have been worked with the transistor transmitter.

A careful calculation and test of power output was made with Read Easton, K6EHV/7, doing the work with the slide rule, vtvm, etc. The output to the antenna was found to be 1.8 milliwatts.

Sunday afternoon, Nov. 25, was the big day! Mac (W7RTT) and I worked 10 stations in 5 states: Minnesota, Tennessee, Alabama, North Carolina and Florida; and with KB6BC on Canton Island and KH6IJ in Hawaii. Canton Island is about 4,500 miles from Tucson.

So far 31 local hams have been worked with this transmitter, some of them many times in a 29-mc net at night. The first local contact on phone with the single transistor amplifier was with W7CDJ in Tucson at a distance of about ¼ mile. Using the push-pull final, on Jan. 13, 1957, we had successful phone contacts with K4AMU in Fort Walton Beach, Fla.; W9OG in Evansville, Ind., and W9IER in Effingham, Ill. Others reported too much QRM or local noise for phone reception.

## Construction problems

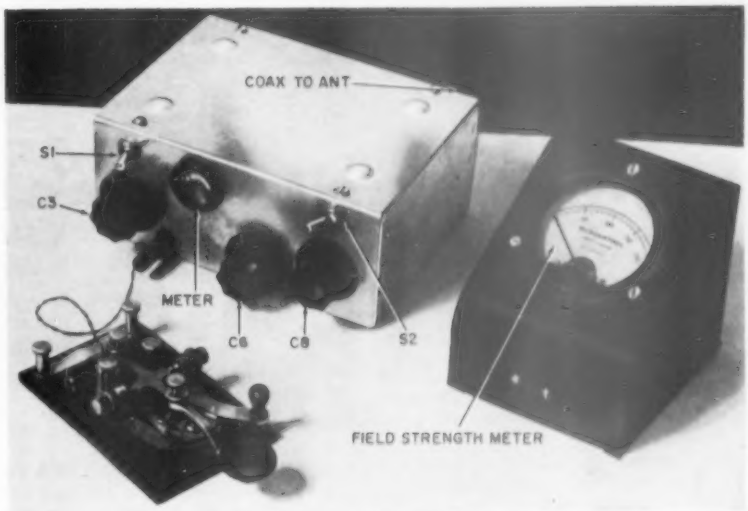
The set is a rather simple one, and little can be said about its construction that has not already been said in the schematic and photographs. When I started on this project, I tried slug-tuned coils in the oscillator and final tank circuits, but they caused spurious radiations on several frequencies simultaneously. This trouble cleared up when I discarded them for conventional coils and capacitors.

I have not found anything unusually critical about the circuit used. No real precedent had been established when I began this transmitter, so the method followed was "try it and see." Trial and error finally gave good results.

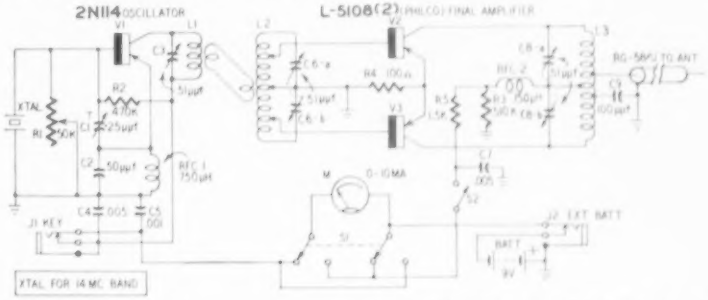
The rig was built into the 7 x 5 x 3-inch aluminum box. The modulator, not shown, uses a carbon microphone and a Motorola 2N176 transistor. It is strictly breadboard construction now. It needs more tests and probable adjustments. This is now connected between R4 and the emitters of the final amplifier transistors, after several earlier tests made with connections at other places in the circuit. So far this gives the best results we have yet gotten.

The original idea of a very small mobile unit is still in the future but, I believe, close to realization. With voice modulation it should be easier to get a reply from the station being called. The CW signal from the transistors is unusually sharp, crystal-clear and very narrow. Many amateurs do not answer our calls because they probably feel that the weak signal is due to conditions or distance and that I will not hear them any louder than they do me.

Transistors are not likely to replace tubes to any great extent in amateur transmitters very soon, but I believe they will serve a valuable purpose in equipment where small size, light weight and low power can be an advantage. END




**Transistorized CW transmitter. Field-strength meter simplifies tuning.**




R1—50,000 ohms, miniature pot
R2—470,000 ohms, ½ watt
R3—510,000 ohms, ½ watt
R4—100 ohms, ½ watt
R5—1,500 ohms, ½ watt
C1—25 μμf ceramic air trimmer
C2—50 μμf, ceramic
C3—51 μμf, miniature variable (E. F. Johnson 50L15 or equivalent)
C4, 7—.005 μf, ceramic
C5—.001 μf, ceramic
C6, 8—51 μμf, 2 gangs, miniature variable (E. F. Johnson 50LD15 or equivalent)
C9—100 μμf, ceramic
L1—9 turns of No. 3006 Miniductor (Barker & Williamson)
L2—No. 3006 Miniductor tapped at center and 5 turns each side of center
L3—No. 3006 Miniductor tapped at center and 2 turns each side of center
RFC1, 2—rf choke, 750 μh
M—0-10-ma dc meter, 1-inch diameter or as desired (International Instruments type 100-C or equivalent)
S1—switch, dpdt toggle with center off position
S2—switch, spst toggle
J1, 2—jack, miniature closed circuit with insulating grommets
V1—transistor, Raytheon 2N114
V2, 3—transistor, Philco L-5108
BATT—battery, 9 volts, dry
XTAL—quartz crystal, 14-mc type for desired 10-meter output
Chassis—7 x 5 x 3 inches with top cover plate
Hookup wire
Hardware

**The complete MOPA transmitter. Key jack is insulated from chassis.**

# Light Meter for Electronic Flash

*Unit can be calibrated in standard light units or used as standard-to-unknown comparator*

By GUY SLAUGHTER

DURING the past few years electronics has invaded the photographic field to give the photographer a new tool, the electronic flashgun, also known as the strobelight.

But up to now electronics has not given the photographer the companion gadget he needs, a light meter capable of measuring the intense and extremely short-duration burst of light strobe equipment produces and translating this value into film exposure data.

The problem of designing such an instrument is an interesting one. It must *measure* a flash of light whose brilliance rivals that of the Sun but which lasts less than a thousandth of a second, it must *time* the duration of the flash and it must *correlate* the two readings into a single film-exposure guide number. Obviously, the ordinary electromechanical light meter is not usable in this service since the inertia of the meter needle itself prevents any appreciable deflection during the life of the light burst, while after the burst decays there is no current left to deflect it. Substituting an oscilloscope for the meter isn't much help, outside of the laboratory, because without complex time-base circuits only the amount of deflection will be readable on the trace. And light intensity alone without light-duration figures is meaningless.

The instrument to be described is an extremely simple approach to the problem but solves it nicely. It is capable of measuring the output of any transient light source and resolving the intensity of the light and its time duration into a single meter reading. This can then be compared to a reading derived from a standard light source whose photographic exposure value is known.

Fig. 1 shows the circuitry of the metering device. V1 is a type 930 phototube whose load resistor R1 is also the grid resistor of V2, a 6SN7-GT with both triode sections paralleled. Capacitors C1 and C2 are the heart of the instrument. With V1 at the dark state (passing no current) C1 charges to 90 volts through R1, which then ceases to pass current. C2 is shunted by R1 and has no charge on it. The grid of V2 is at ground potential, while the cathode is held sufficiently above ground by its bias voltage to cut off the tube. So long as V1 remains at the dark state, V2 passes no current and its plate meter, a 0–1 milliammeter, reads zero.

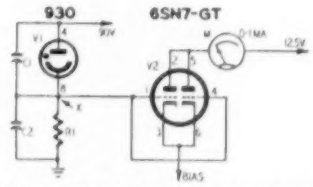


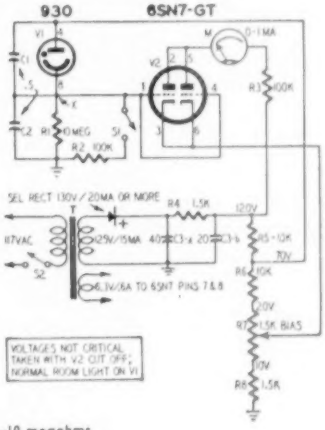

**Fig. 1—The basic metering circuit.**

Now a burst of light impinges on V1 and it momentarily passes current. The amount of current it passes is proportional to the intensity of the light falling on it and the length of time it conducts is proportional to the duration of the light burst. During the instant the phototube is excited, C1 partially discharges through the anode–cathode path of V1, the rate of discharge being dependent on the intensity of the exciting light and the length of time the discharge continues dependent on the duration of the light burst.

Because current flows through R1 there is a voltage drop across it, proportional to the amount of current flowing. Therefore C2 assumes a charge proportional to the voltage drop across R1 as well as to the length of time the voltage drop exists. Since point X is now above ground potential, the grid of V2 is driven positive, the tube conducts and current flows through its plate meter which deflects by an amount proportional to both the intensity and the duration of the light. Meter-needle inertia is no longer a limiting factor since the discharging of C2 and the recharging of C1 holds point X at its peak reading for a relatively long period of time.

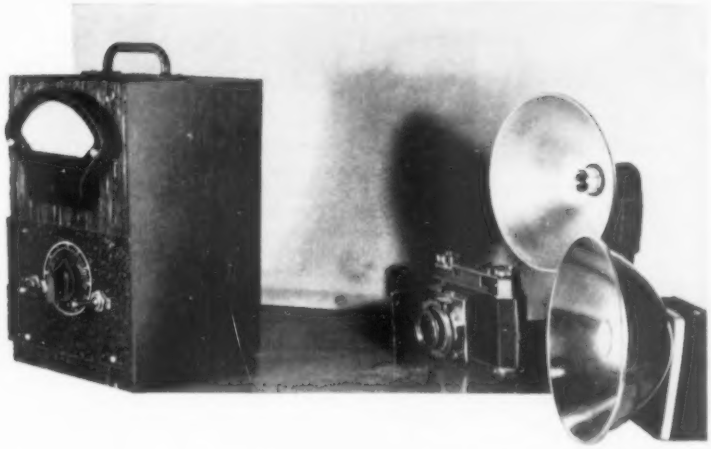
Now the burst of light has passed. C2 discharges and C1 recharges. Point X gradually falls back to ground potential, as does the grid of V2. The meter in the plate circuit of V2 therefore drops back toward zero. After about 30 seconds the entire circuit resumes its dark-state condition, ready to meter another burst of light.

Fig. 2 shows the circuit with its power supply, a simple half-wave rectifier affair. The power transformer is a 1-to-1 job, delivering about 117 volts across the secondary as well as the 6 volts feeding the filament. None of the components is at all critical, with the exception of the 100,000-ohm resistor feeding the plate circuit of the 6SN7; juggling this particular value results in considerable loss of




R1—10 megohms
R2—100,000 ohms
R3—100,000 ohms, 5%
R4—1,500 ohms, 1 watt
R5, 6—10,000 ohms
R7—1,500 ohms, pot
R8—1,500 ohms
*All resistors ½ watt unless otherwise noted*
C1, 2—0.5 µf
C3—40–20 µf, 250 volts, electrolytic
T—isolation transformer, approximately 1:1, secondary 117–125 volts @ 15 ma
SEL RECT—selenium rectifier, 130 volts, 20 ma (or more)
S1, 2—spst switches
V1—930 phototube
V2—6SN7-GT
Octal sockets (2)
M—milliammeter, 0–1
Line cord
Chassis

**Fig. 2—Schematic of the light meter. Simple half-wave rectifier is used.**



Instrument is housed in plywood box. Note hole cut into side opposite the sensitive element of the phototube.

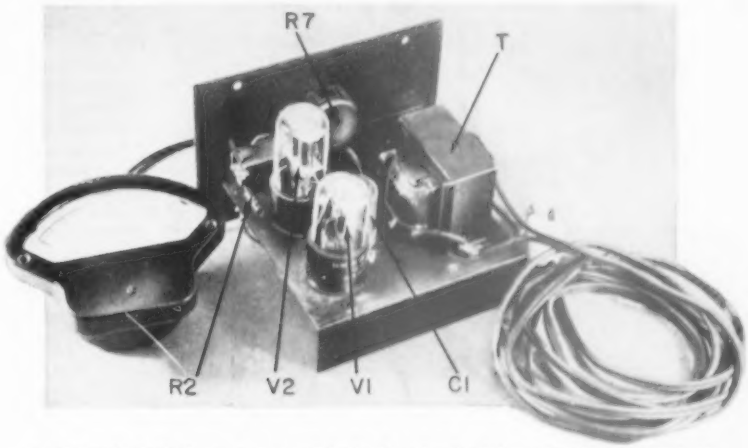
linearity in the meter scale. Switch S1 was included to hasten decay time and speed up the return to zero of the meter after a reading has been taken. The bias potentiometer (R7) permits zeroing the meter under different conditions of room lighting and, within limits, has very little effect on light burst peak readings.

The instrument is housed in a plywood box. A 1-inch hole cut into the side of the box opposite the cathode (curved element) of the phototube permits exciting light to enter, while shielding it from extraneous room lights.

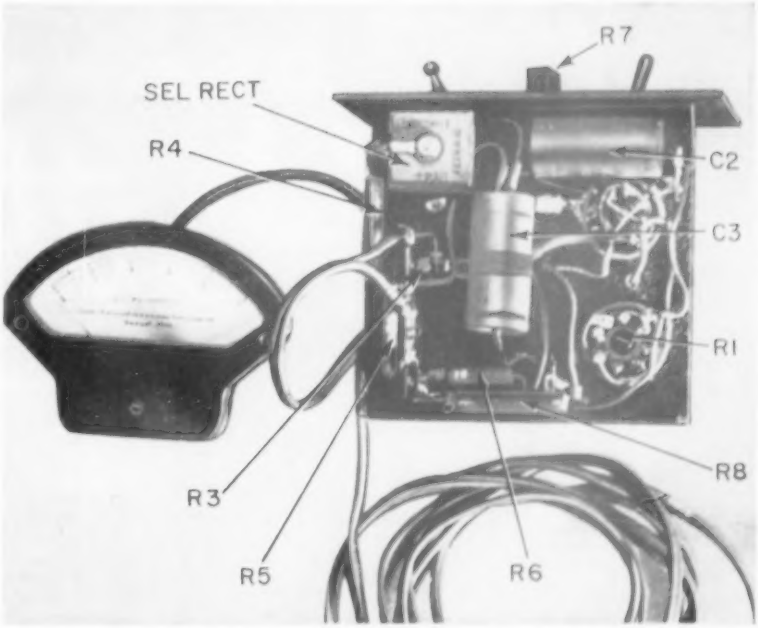
The meter can be calibrated in standard light units or it can be used, without calibration, as a standard-to-unknown comparator. This latter practice is recommended, and a typical example of the instrument's use in this manner follows:

We are interested in obtaining exposure information on an ultra compact strobe unit. The manufacturer's exposure data sheets were erroneous and useless. We set the light meter up on a bench, measured off four arbitrary distances of 48, 56, 60 and 70 inches from the instrument. We then fired a standard flash bulb (Norelco PF3), whose exposure index was 195 for the type of film we wished to use, from each of the previously measured positions, and noted the meter readings. They ran 0.82, 0.56, 0.26 and 0.14 mil, respectively.

We then set up the strobe unit and fired it into the instrument, varying the distances between the strobe and the meter until we got four current readings identical with the first four. These distances were 17, 20, 21½ and 25 inches. By dividing the flash-bulb distance into the strobe distance for each meter reading, we got the same percentage figure of 0.357 in each instance. Therefore, the exposure index of the unknown light source was 0.357 that of the known source, or 70 for fast black-and-white film. A roll of film exposed at this index yielded crisp, properly dense negatives, confirming our computations. END




**Small unit is built on 5 x 5 x 1-inch chassis. Position of 930 is important.**




**The power supply components, C2 and most of the wiring occupy the under side.**

* *An improved model of what was already an outstanding instrument.*
* *Performance is unmatched in this price range.*
* *Incorporates the extra features required for color TV servicing.*

**HEATHKIT ETCHED CIRCUIT, PUSH-PULL**

# 5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2' DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

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*New* HEATHKIT ETCHED CIRCUIT

# 5" Oscilloscope Kit

- *Brand new model with improved performance specifications.*
- *Full 5" scope for service work at a remarkably low price.*
- *Attractively styled front panel in charcoal gray with sharp white lettering.*
- *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

**$42.50**

Shpg. Wt. 21 Lbs.

### HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

**$3.50**

Shpg. Wt. 1 Lb.

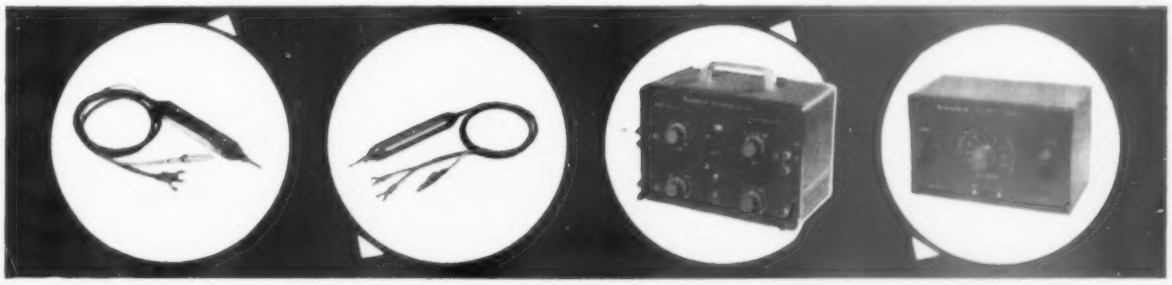
### HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

**$21.95**

Shpg. Wt. 8 Lbs.



### HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

**$3.50**

Shpg. Wt. 1 Lb.

### HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

**$12.50**

Shpg. Wt. 4 Lbs.

## HEATHKIT ETCHED CIRCUIT VACUUM TUBE

MODEL V-7A

**$24.50**

Shpg. Wt. 7 Lbs

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

# Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

### HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

**$3.50**

Shpg. Wt. 1 Lb.

### HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

**$29.50**

Shpg. Wt. 6 Lbs.

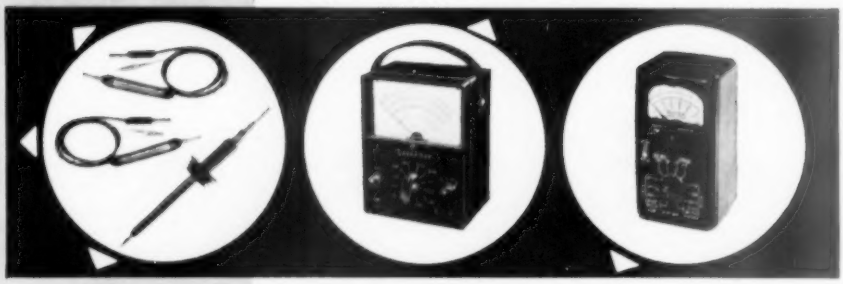
### ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C

**$5.50**

Shpg. Wt. 2 Lbs.



### HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

**$4.50**

Shpg. Wt. 2 Lbs.

### HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

**$14.50**

Shpg. Wt. 3 Lbs.

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**HEATHKIT NEW AUDIO VACUUM TUBE**

# Voltmeter Kit

* *Brand new circuit for extended frequency response and added stability.*
* *Ten accurate ranges from 0-.01 to 0-300 volts.*
* *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3
**$29.95**
Shpg. Wt. 5 Lbs.

### HEATHKIT AUDIO WATTMETER KIT

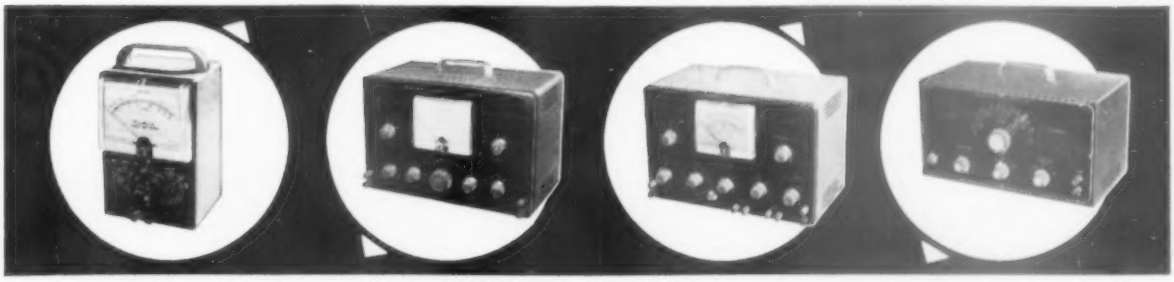
This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1
**$29.50**
Shpg. Wt. 6 Lbs.

### HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1
**$49.95**
Shpg. Wt. 13 Lbs.



### HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1
**$49.50**
Shpg. Wt. 13 Lbs.

### HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1
**$24.50**
Shpg. Wt. 10 Lbs.

HEATHKIT

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

# Audio Generator Kit

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

### HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

### HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

### HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

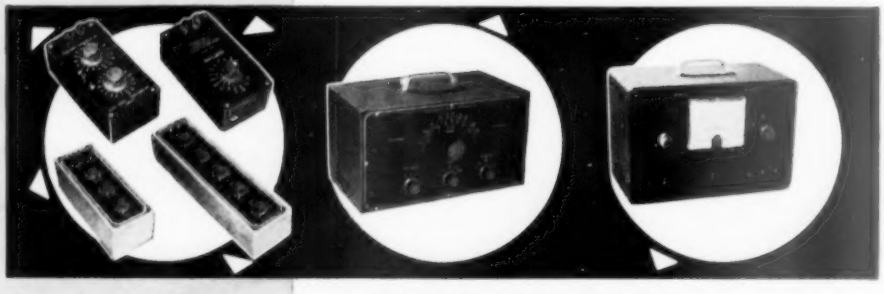
### HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.



### HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

### HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

**HEATH COMPANY**

*A Subsidiary of Daystrom, Inc.*

**BENTON HARBOR 20, MICH.**

**BONUS PERFORMANCE . . .**

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

# Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*

MODEL SG-8

**$19.50** Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

### HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

**$48.95**

Shpg. Wt. 16 Lbs.

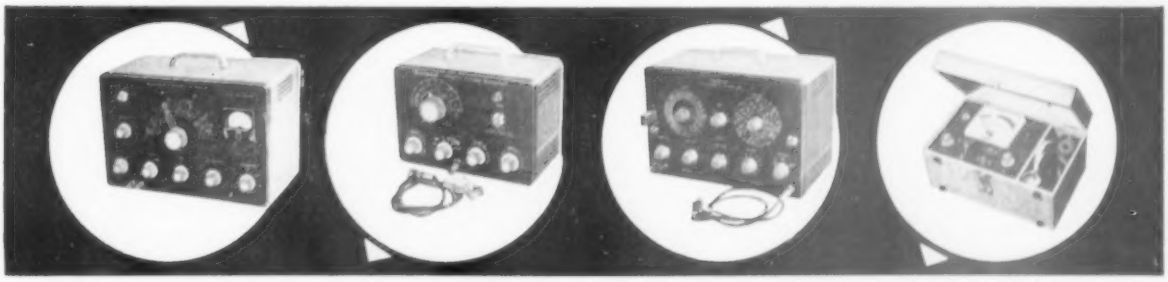
### HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

**$49.50**

Shpg. Wt. 16 Lbs.



### HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

**$22.50**

Shpg. Wt. 7 Lbs.

### HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

**$22.50**

Shpg. Wt. 10 Lbs.

HEATHKIT

# Tube Checker Kit

MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

### HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

### HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

### HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.

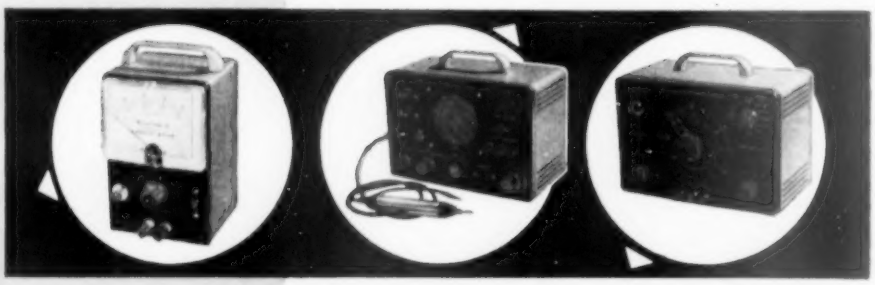
### HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.



### HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

**HEATH COMPANY**

*A Subsidiary of Daystrom, Inc.*

**BENTON HARBOR 20, MICH.**

**PIONEER DESIGN . . .**

New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

# Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.

MODEL IB-2

**$59.50** Shpg. Wt. 12 Lbs.

### HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

**$44.50**

Shpg. Wt. 14 Lbs.

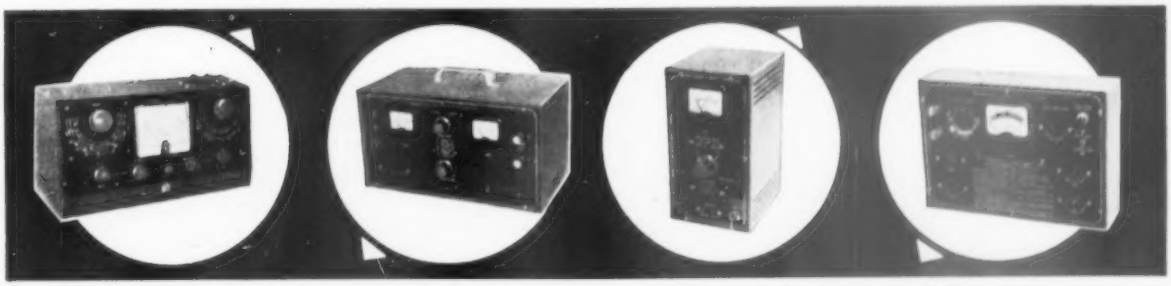
### HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

**$16.50**

Shpg. Wt. 9 Lbs.



### HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

**$31.50**

Shpg. Wt. 17 Lbs.

### HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

**$14.50**

Shpg. Wt. 6 Lbs.

## HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

**$189.50**

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

# Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

### HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

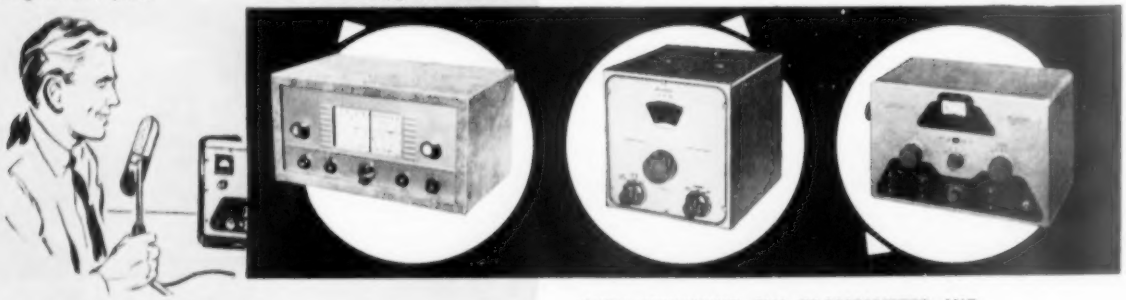
**CABINET:** Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95

MODEL AR-3
**$29.95**
INCLUDING NEW EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

### HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
**$19.50**
Shpg. Wt. 7 Lbs.



### EASY ON THE BUDGET!

*You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.*

### NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20
**$35.95**
Shpg. Wt. 18 lbs.

**HEATH COMPANY**
*A Subsidiary of Daystrom, Inc.*
**BENTON HARBOR 20, MICH.**

**DOLLAR-SAVING ECONOMY . . .**

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

### HEATHKIT PHONE AND CW

# Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off–CW–stand-by–phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

**$56.95** *Shpg. Wt. 24 Lbs.*

### HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

**$14.50**

*Shpg. Wt. 2 Lbs.*

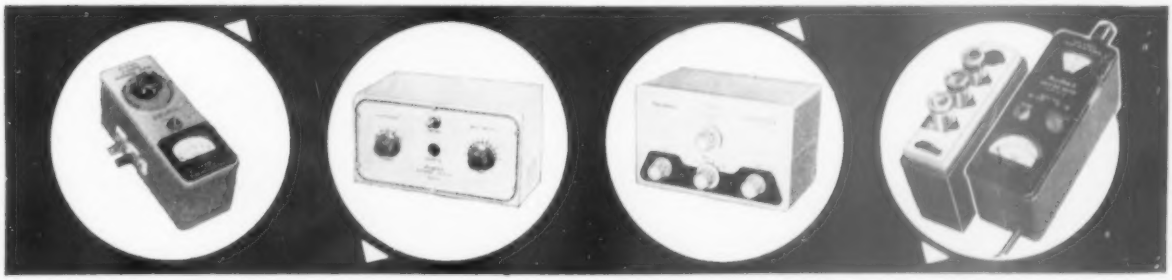
### HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

**$9.95**

*Shpg. Wt. 3 Lbs.*



### HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

**$14.50**

*Shpg. Wt. 4 Lbs.*

### HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

**$19.95**

*Shpg. Wt. 4 Lbs.*

## HEATHKIT BROADCAST BAND

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX*

# Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

**CABINET:** Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95*

### ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

### HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

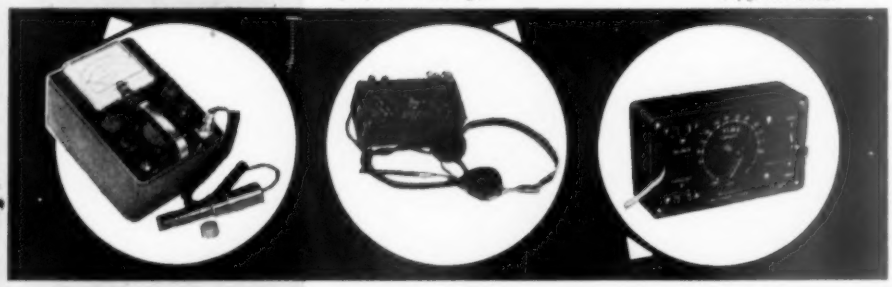
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

### HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX*
Shpg. Wt. 3 Lbs.



- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

### HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

**HEATH COMPANY**
*A Subsidiary of Daystrom, Inc.*
**BENTON HARBOR 20, MICH.**

**COMPREHENSIVE INSTRUCTIONS . . .**

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

**HEATHKIT HIGH FIDELITY**

# Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

**$19.75**

**HEATHKIT HIGH FIDELITY FM TUNER KIT**

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

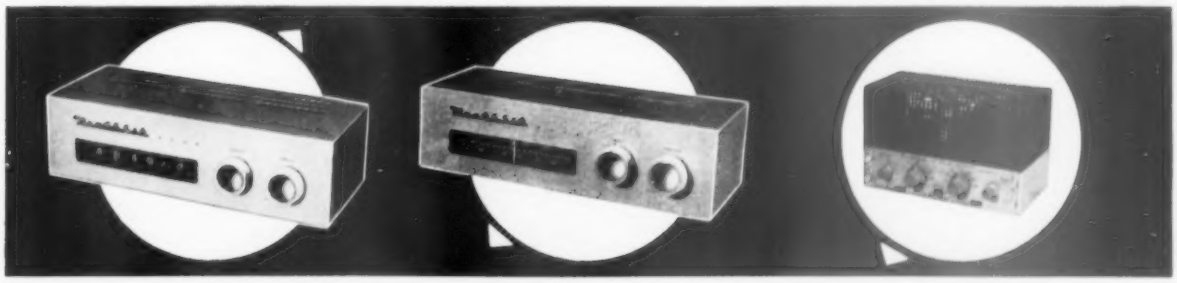
This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

**$25.95**

INCLUDING NEW EXCISE TAX

(With Cabinet) Shpg. Wt. 7 Lbs.



**HEATHKIT BROADBAND AM TUNER KIT**

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

**$25.95**

INCLUDING NEW EXCISE TAX

(With Cabinet) Shpg. Wt. 8 Lbs.

**HEATHKIT ELECTRONIC CROSS-OVER KIT**

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

**$18.95**

Shpg. Wt. 6 Lbs.

## HEATHKIT ADVANCED-DESIGN

**MODEL W-5**

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

*HIGH FIDELITY*

# Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

### HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

**MODEL W-3M:** Shpg. Wt. 29 Lbs. Express only.....$49.75

**MODEL W-3:** Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only.....$69.50

### HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

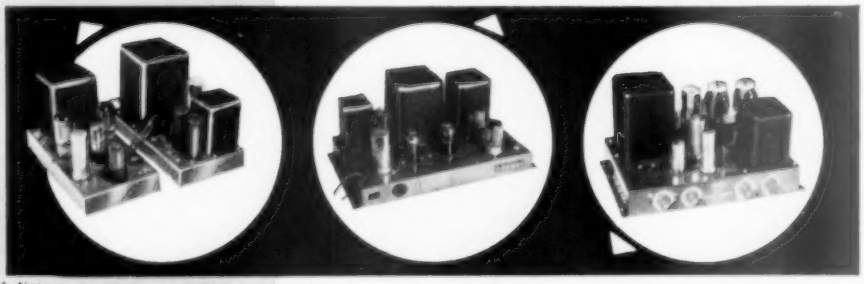
The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

**MODEL W-4AM:** Shpg. Wt. 28 Lbs. Express only.....$39.75

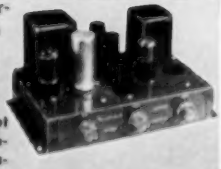
**MODEL W-4A:** Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only.....$59.50

### HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 Lbs.



MODEL A-7D
**$17.95***
INCLUDING NEW EXCISE TAX



**MODEL A-7E:** Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. **$19.95‡**

### HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
**$35.50***
*Shpg. Wt. 23 Lbs.*

**HEATH COMPANY**
*A Subsidiary of Daystrom, Inc.*
**BENTON HARBOR 20, MICH.**

All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

# Range Extending
## SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*

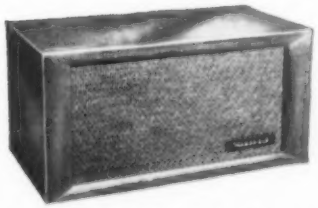
This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

MODEL
SS-1B

**$99.95**

Shpg. Wt. 80 Lbs.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**



MODEL
SS-1

**$39.95**

Shpg. Wt. 30 Lbs.

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

**HEATH COMPANY** *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

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# ELECTRONICS TIMES TRAFFIC SIGNALS

Technician adjusts timing on traffic signal.

By LEO G. SANDS

EVEN the familiar traffic signal, which sometimes aids the flow of automobile traffic and at other times adds to the congestion, is receiving the attention of electronics engineers and technicians. Most traffic signals are still electromechanically controlled but many now employ electronic circuitry.

One application of electronics in traffic control is in timing circuits of traffic signals. At least four manufacturers are currently building electronic traffic-control timers in the United States. All of them are similar in that they depend upon R-C networks wherein time is measured by discharging a capacitor through a resistor.

Time can be measured accurately with an R-C circuit. One second is the time required for a 1-$\mu$f capacitor to discharge through a 1-megohm resistor to 33% of its original charge voltage. If a 10-$\mu$f capacitor is used, 10 seconds are required. Or if a 10-megohm resistor is used across a 1-$\mu$f capacitor, it will take 10 seconds for the voltage across the charged capacitor to drop to 33% of its original value. The basic formula is: $t = RC$, in which t is time in seconds, R resistance in ohms and C capacitance in microfarads.

Fig. 1 illustrates a basic electronic traffic-signal timer circuit utilizing a triode thyratron. The grid of the thyratron is biased with a fixed negative voltage so that conduction will not take place until the plate voltage has reached a certain value. A relay is connected in the plate circuit of the tube and a 5-$\mu$f capacitor is connected from the B-plus side of the relay to ground. The capacitor is charged through variable resistor R. Fig. 2 shows the operating characteristic of this type of circuit.

The thyratron tube is biased so that it conducts at 63% of full B-plus voltage. When it conducts, the capacitor discharges through the relay and the gas tube (thyratron), energizing the relay and causing a controlled stepping element to advance to its next position. This advance short circuits the capacitor and the tube is de-ionized. Timing with this circuit is very accurate, and timing adjustment is made by varying resistor R. Hence, while changing the amount of resistance in the circuit affects the timing, it does not affect the voltage at which thyratron conduction occurs—this remains 63% of the source voltage.

A novel traffic-control timing circuit is shown in Fig. 3. This circuit operates from an ac source and depends upon grid rectification to charge the timing

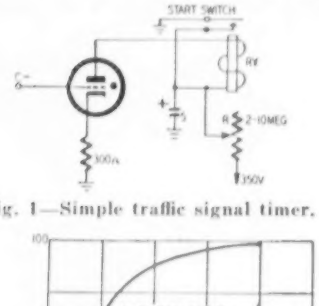



Fig. 1—Simple traffic signal timer.

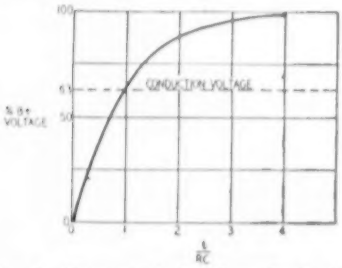



Fig. 2—Characteristic of an R–C timing circuit.

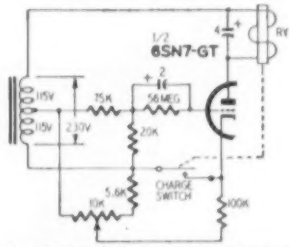



Fig. 3—Control circuit operates from an ac source and uses grid rectification.

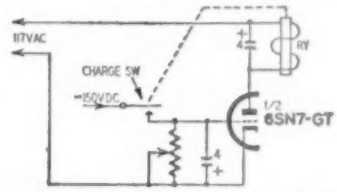
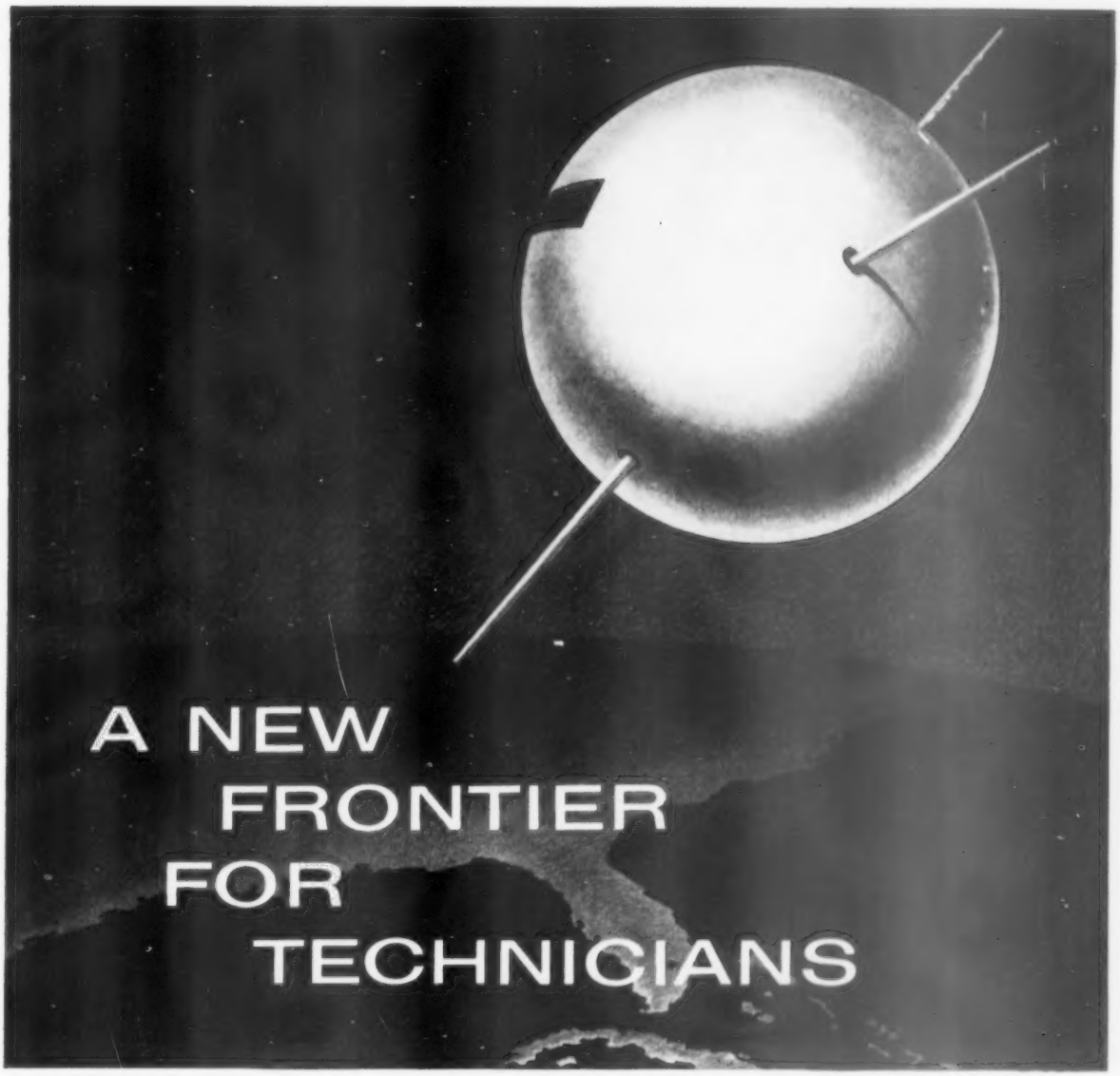



Fig. 4—Grid capacitor is charged from a negative voltage dc.

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**RADIO CORPORATION of AMERICA**

capacitor. The voltage to which the timing capacitor is charged is determined by the ac voltage applied between the grid and cathode. A triode vacuum tube is used in this circuit and in commercial applications is generally half of a 6SN7 twin triode.

A rather simple timing circuit is shown in Fig. 4. Here again, one section of a twin triode is used. The circuit is a conventional R-C arrangement in which the grid capacitor is initially charged from a negative dc source (−150 volts) and the charge is then allowed to leak off through the timing-control resistor. Ac is applied to the plate through the relay coil.

A pentode type tube is used in the circuit illustrated in Fig. 5, operated with dc on the grid and ac on the plate. The timing capacitor is initially charged to approximately −150 volts. The capacitor is not discharged in the manner of the circuit shown in Fig. 4. Instead, it is discharged into a voltage-divider network which is adjustable from 0 to 150 volts opposite in polarity to the capacitor charging voltage. Timing variations are obtained by adjusting this voltage divider. With the contact of the voltage divider at ground potential, a long time constant is obtained as shown in curve A of Fig. 6. With the capacitor discharge circuit fed into a positive voltage as when the contact arm is above ground potential, the time constant is shorter curve B.

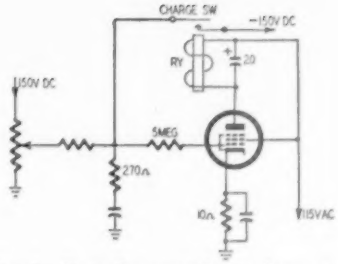



**Fig. 5—Pentode control circuit uses dc on grid and ac on plate.**

Other electronic circuitry is being used in traffic control employing some rather complex electronic computers and data transmission circuits and it is conceivable that even more complex devices will appear in the future to help unsnarl the ever-increasing traffic problem which is taking away some of the former pleasure of driving an automobile.

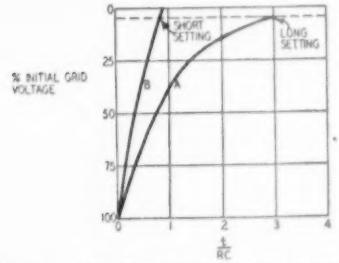
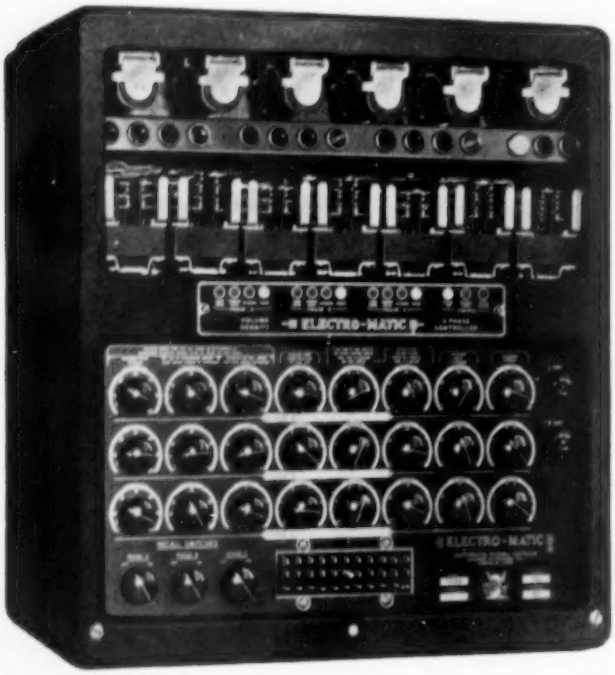
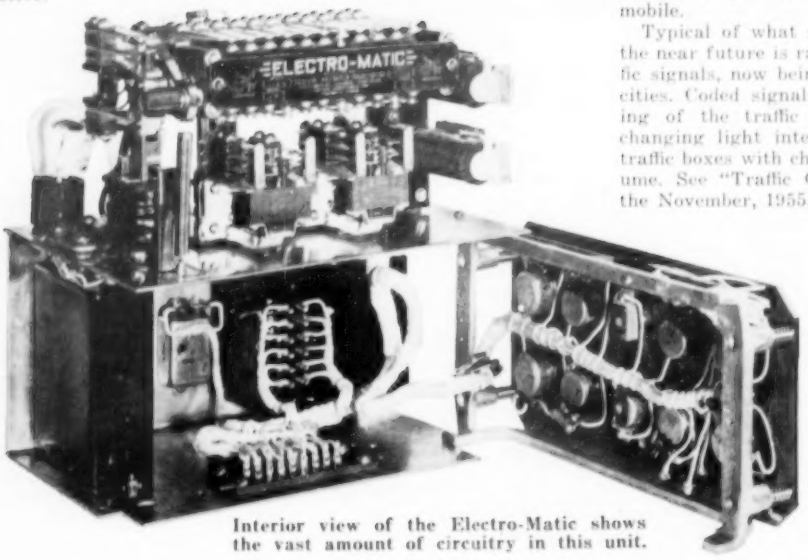



**Fig. 6—Discharge curves for different settings of Fig. 5 potentiometer: A, center arm at ground potential; B, arm is at some positive voltage.**

Typical of what may be expected in the near future is radio control of traffic signals, now being tested in several cities. Coded signals regulate the timing of the traffic lights and permit changing light intervals in individual traffic boxes with changes in traffic volume. See "Traffic Control System" in the November, 1955, issue. END




**Panel view of the Electro-Matic 1033 controller.**




**Interior view of the Electro-Matic shows the vast amount of circuitry in this unit.**

Fig. 1—Sensing unit that detects moisture in air.

*New device meters moisture in the air and provides precise control of humidity for critical industrial processes*

# How electronics controls HUMIDITY

By THOMAS L. BARTHOLOMEW

AN electronic device introduced in the industrial field by the Barber-Coleman Co. of Rockford, Ill., regulates humidity in a given space. It controls the relative humidity to any value between 25 and 95% and can be arranged either to increase or decrease the moisture content of the air.

This equipment is finding wide acceptance in rooms where humidity is of the utmost importance (textile weaving rooms, test laboratories, conditioning rooms, etc.).

Fig. 1 is the controlling element. It consists of two wires wound on a polystyrene cylinder. These wires act as electrodes. After the wires are wound on the cylinder, a coating of lithium chloride solution is applied. The lithium chloride forms a conductive path between the two wires. It changes resistance when the moisture content in the surrounding air changes, thus forming the basis for the whole operation.

## How it works

Fig. 2 shows the schematic wiring arrangement and Fig. 3 is a photo of the equipment. The sensing element is connected across one section of the 12-volt bridge circuit that supplies the first grid of the 6SC7. As the resistance of the sensing element rises or falls, the signal applied to the first grid is varied. This signal is amplified through the resistance-coupled network and controls the balancing circuit built around the 6SN7. A rise in signal to the 6SN7 causes the grounded-grid section to be more conductive and thereby causes current to flow in one direction in the plug-in relay, closing one of the contacts and causing the control motor to run in one direction.

The balancing rheostat is mechan-

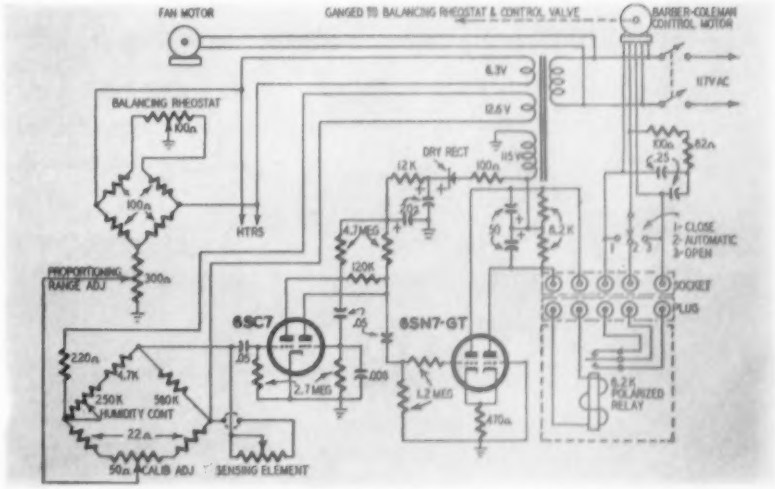
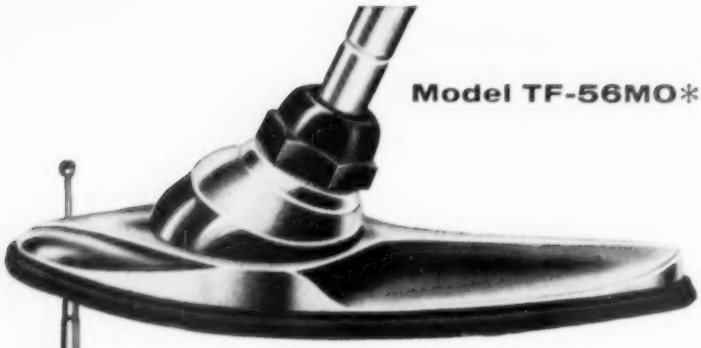



Fig. 2—The complete control, showing electronic circuits and control motor.



Model TF-56MO*

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- ★ 54″ lead-in

Order your WARD Tear Drop Mounts today. Replace old antennas with these finest, newest models with that sales-appealing original equipment look. Write now.

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**Individual Shipping Wt. 1-lb.**

RE-5

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**Fig. 3—Front view of control unit. Controls on three small square panels in center of photo, from left to right: humidity control, calibration adjustment, three-position switch.**

ically connected to the gear train driven by the control motor. The purpose of this rheostat is to change the balance in the 6-volt bridge circuit so that, when the sensing element has made a change and caused the control motor to operate, the balancing rheostat's electrical action will cause the signal applied to the first grid in the 6SC7 to return to a null or balance value. This type of control is known as proportioning. Without the balancing rheostat, the control motor would, upon the slightest change of the sensing element, either completely open or close the device it was operating. With the balancing rheostat the control motor moves only to the extent of the change in the sensing element.

A decrease in the signal to the 6SN7 will cause the opposite section of the tube to be more conductive—the current will now flow in the opposite direction in the polarized relay and close the opposite contact, causing the control motor to run in the other direction.

The balancing rheostat and the control motor are mounted together. Fig. 4 shows the proportioning control motor mounted on a steam valve. The steam adds moisture to the atmosphere. The resistance–capacitance network shown connected in the motor leads is merely for the purpose of reducing arc at the contacts. An air-circulating fan is installed in the lower part of the cabinet when the sensing element is mounted in the cabinet. When the sensing element is mounted remotely, the circulating fan is not used.

### Operation and controls

At the top of the humidity control unit (Fig. 3) can be seen the two tubes with the plug-in relay to the right and the off–on toggle switch at top right. The adjustment knobs are in the center, the sensing element at the bottom left

# Pharaoh had the words for it!*

*Photos courtesy of the Metropolitan Museum of Art*

*hearken

ye

it is
indeed
that

the voice of

Unibrsity

(symbol for
loudspeaker)

(is) good

more than
anything

The pyramid builders had no high fidelity loudspeakers, but their ancient language had the "words" for this ultra-modern development . . . as demonstrated by this translation into hieroglyphics of University Loudspeakers' slogan.

It's a slogan University proudly introduced to the high fidelity field because it summarizes our aim: *to provide you with truly better listening.*

Words can try to describe this superior sound . . . but the rich tonal pleasure offered by these loudspeakers is experienced only when you *hear* them.

So whether in hieroglyphics . . . or in Chinese, Arabic, Greek, Sanskrit or Hindustani used in other University advertisements . . . this slogan conveys our sincere invitation to visit your dealer and . . .

LISTEN *University sounds better*

*Translation into Early New Kingdom monumental type hieroglyphics by Cyril Aldred, associate curator of the Department of Egyptian Arts, the Metropolitan Museum of Art, N.Y.C.*

"Listen, University Sounds Better" posed novel difficulties to Egyptologists when translated to hieroglyphics. For example, the simple English request, *listen,* became *hearken ye, it is indeed that.* There was no Egyptian verb for *to sound, so the voice of* was substituted. And since the Ancient Egyptians used no comparative forms of adjectives or adverbs, they had no word for *better;* instead, the labored construction *good, more than anything* was substituted.

For *University* the "easy" symbol of *school for scribes* could not be used, since the name refers here to a manufacturer. *A brand new "high fidelity" hieroglyphic was developed* by "vocalizing"—phonetically spelling out—University as *unibrsity* (there was no "v" in Ancient Egyptian). Then, just as the Egyptians did when inventing a hieroglyphic for an object, a picture of the loudspeaker was added . . . thus bringing a 4,000-year-old form of picture writing up to date on 20th century high fidelity sound!

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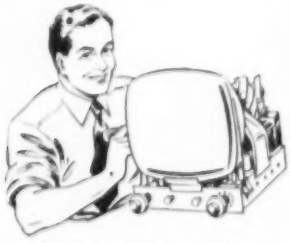
Throughout, this 669-page book with its 417 clear illustrations gives you the kind of above-average **professional training that fits you for** the better, big pay jobs in either servicing or general electronics. Covers all circuits in modern TV and radio receivers, amplifiers, phono-pickups, record players, etc. Price only $6.75 . . . or see money-saving offer in coupon. **Examine it 10 days at our risk!**



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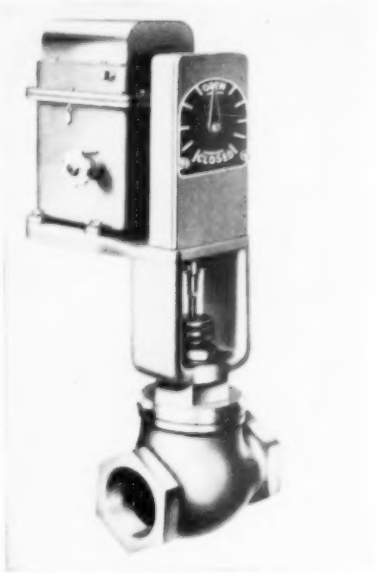

**Fig. 4—Control motor is mounted on steam valve.**

and the circulating fan at the bottom right.

These instruments are very simple to operate and the maintenance cost is low. The control knob on the left (the 250,000-ohm pot on the bridge in the schematic) is to set the instrument for the percent of humidity desired. The center control (50 ohms) is the calibration adjustment. It should be moved only at the time of installation or if the sensing element is changed. The control on the right is a three-position switch. The center position is its normal operation. Turning the pointer to the right causes the control motor to close the device it is operating. Turning the knob to the extreme left causes the control motor to reverse its action. The sensing element (Fig. 1) is protected by a perforated guard to prevent contact with the active surface during handling. If the air stream contains foreign matter that may accumulate on the active surface of the sensing element, a special moisture-admitting cellophane envelope is wrapped around the perforated guard. The active surface must be kept clean. END

IN GLAMOROUS NEW YORK CITY—ALL EXPENSES PAID PLUS $100 CASH

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**1st PRIZE:** One 4-drawer steel file cabinet plus your choice of 50 sets of PHOTOFACT folders. Value: $120.45.

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**TEN 5th PRIZES:** 10 JENSEN professional speaker units consisting of a D-30 lifetime driver unit **and** RT-20 rectangular horn. dlr. net $44.40 per set.

**FIFTEEN 6th PRIZES:** 15 TW CHANNEL MASTER 7 element "traveling wave" TV antennas, Model 350. dlr. net $33 ea.

**EIGHTEEN 7th PRIZES:** 18 PYRAMID Pyra-Pak kits consisting of $69.95 in Pyramid capacitors, metal tool box and tool kit. dlr. net $29.95.

**THIRTY-FIVE 8th PRIZES:** 35 PYRAMID gift certificates entitling you to $10. (dlr. net) of Pyramid capacitors at your distributor.

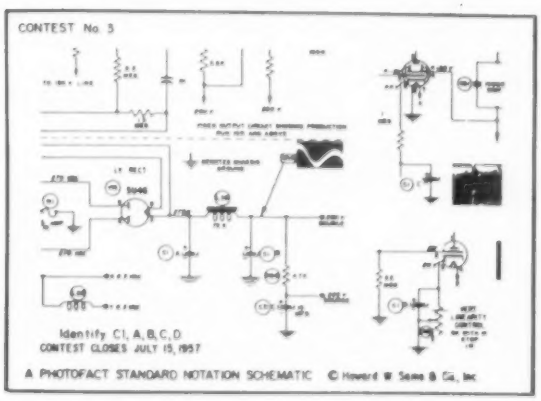
**9th PRIZE:** WALCO twin-point diamond phono needle. dlr. net $30. For G.E. Var. Rel. Cartridge.

**FIFTY 10th PRIZES:** 50 WALCO needles for G.E. twin-point sapphires. $3.50 dlr. net.

**AND** to **all entrants** a kit of 5 bypass and coupling capacitors featuring the Pyramid type IMP.

**It's easy to win any one of 147 big prizes—just follow these simple rules:** Identify the unnamed Pyramid T-M capacitor in the TV set schematic appearing on this page. Give the Pyramid stock number, name and model number of TV set. Then mail your entry to Pyramid. Use coupon on this page or obtain additional blanks from your distributor. A different schematic will appear in these servicemen's magazines for 4 months. Prizes will be awarded on a points-earned basis as follows: 5 points for Contest No. 1; 10 points for Contest No. 2; 15 points for Contest No. 3; 20 points for Contest No. 4; and 10 points each contest for neatness. Possible perfect score: 90 points. However it is not necessary to achieve a perfect score to be declared a prize winner.

So act quickly...send in your entries early each month...you can't lose.




**JUDGES:** M. Harvey Gernsback, editorial director, Radio-Electronics
Oliver Read, D.Sc., publisher, Radio & Television News
Howard W. Sams, Chmn. Board, Howard W. Sams, Inc.

### HELPFUL HINTS

The unidentified capacitor in each entry will be a Pyramid Twist-Mount. All schematics are of TV sets made in the U. S. by a known manufacturer within the past 2 years.

Schematics for reference may be those published by the TV set manufacturers, Howard Sam's Photofacts, or by any other accepted publisher. You may enter as often as you like but be sure to include a box top (showing stock number) of any Pyramid Twist-Mount Capacitor, with your letterhead or business card with each entry.

### WHO MAY ENTER

Any Radio-TV serviceman or employee of a Radio-TV service company may enter. Officers, employees, (members of their families) of Pyramid Electric Co. or its advertising agency are not eligible to enter the contest. All entries are limited to residents of the continental U. S. over 21 years of age.

All entries become the property of Pyramid Electric Co., none will be returned and the decisions of the judges are final. In case of ties, duplicate prizes will be awarded. This contest is subject to all federal, state and local laws and regulations.

### MAIL THIS ENTRY BLANK NOW!

**Pyramid Twist-Mount Contest, Dept J**
**Pyramid Electric Co.**
**P.O. Box 655, Tyler Park Station, North Bergen, New Jersey**

Entry No. (1) (2) (3) (4)—(check one)—is: Pyramid stock No. _____

Twist-Mount values _____

Set manufacturer's name _____ TV set model No. _____
I enclose a box top (indicating stock number) of any Pyramid Twist-Mount Capacitor together with my business card or letterhead or my employer's).

Contestant's name _____ Position _____

Contestant's address _____

City _____ Zone ____ State _____

Employer's Firm name _____

Employer's address _____

City _____ Zone ____ State _____

My jobber's name and address _____

**ENTER AS OFTEN AS YOU LIKE—FOR ADDITIONAL ENTRY BLANKS SEE YOUR JOBBER.**

Capacitors, Selenium Rectifiers—for original equipment, for replacement

**PYRAMID ELECTRIC COMPANY** North Bergen, New Jersey

# rhomboids for TV reception

*Constructing high-gain rhombic antennas for vhf and uhf*

By H. W. KLINE

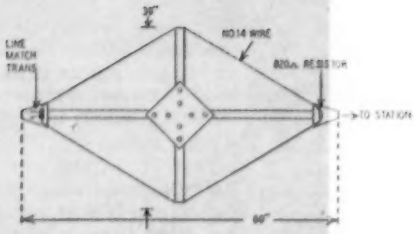



**Fig 1—Dimensions of a 2-wavelength rhombic antenna for reception at 85 mc.**

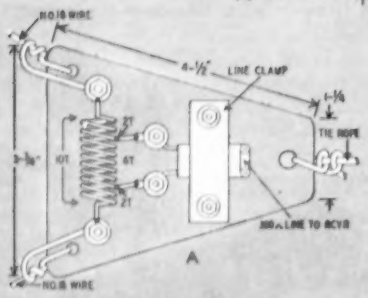



**Fig. 2-a—Line coupling unit has stepdown transformer to match 300-ohm line to 800-ohm rhombic.**

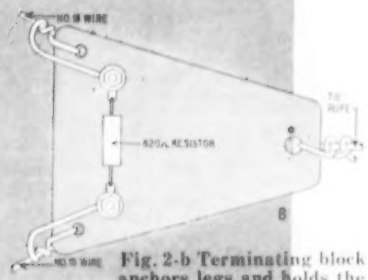



**Fig. 2-b Terminating block anchors legs and holds the 820-ohm terminating resistor.**

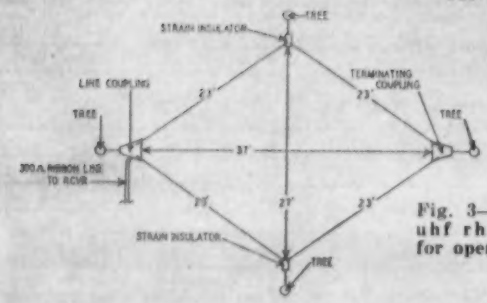



**Fig. 3—A 2-wavelength uhf rhombic antenna for operation at 680 mc.**

THE town of Cleverdale, N. Y., is located on a point projecting to the north from the southeast shore of Lake George. On the west is Harris Bay and on the east Van Warmer and Kattskill Bays. South of Cleverdale are fairly high hills such as French Mountain and Top of the World. To the east is a range running up the east shore to Pilot Knob. The point is fairly well hemmed in and densely covered with towering elms.

Many fancy TV antennas have been installed on the point; multielement Yagis and doublets with up to six directors and sometimes several reflectors. These have been installed at various elevations in attempts to bring in better signals from WRGB, the only vhf station receivable in this area. WRGB transmits on channel 6 with picture frequency at about 85 mc.

The airline distance from WRGB's transmitter to Cleverdale is approximately 70 miles. A survey of reception around the point indicated pictures with much snow and many ghosts due to multipath reception from the surrounding hills. Taking all conditions into consideration, it was decided a 2-wavelength, diamond rhombic antenna, due to the size of its aperture, might integrate all the various signal components arriving from all angles, phase them correctly and deliver a much more satisfactory signal with no ghosts. It was also decided that it would be easy to sling such an antenna between four trees even though there might be several other tree trunks in the aperture.

A 2-wavelength rhombic with a 5° wave angle for 85 mc was designed for a trial. It was estimated that this diamond network should be elevated 26 feet above ground for the desired wave angle. The antenna was assembled completely on the lawn of a residence in Schenectady, wound up on a paper carton and taken to Cleverdale where it was erected as planned in the trees over our camp. A Magnavox 21-

(*Continued on page 89*)

Superior's New Model 770-A

## The FIRST Pocket-Sized VOLT-OHM MILLIAMMETER

### USING THE NEW "FULL-VIEW" METER 71% MORE SCALE AREA!

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

• Compact — measures 3⅛" x 5⅞" x 2¼". • Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications — • 6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts. 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm. 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps. 3 DECIBEL RANGES: −6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with self contained batteries, test leads and all operating instructions.

**$15.85 NET**

Superior's New Model TV-60

## 20,000 OHMS PER VOLT ALLMETER

### SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per volt) 0 to 15/75/150/300/750/1500/7500/10,000 Volts.
7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per volt) 0 to 15/75/150/300/750/1500/7500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES: −6 db to + 58 db.

AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified at right except that it is used for the location of cause of trouble in all audio and amplifier systems.

R.F. SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

### FEATURES

Giant recessed 6½ inch 40 Microampere meter with mirrored scale. Built-in Isolation Transformer. Use of the latest type printed circuit and 1% multipliers assure unchanging accurate readings.

Model TV-60 comes complete with book of instructions, pair of standard test leads, high-voltage probe, detachable line cord, R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Plastic bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

**$52.50 NET**

Superior's New Model TW-11 STANDARD PROFESSIONAL

## TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyraton, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc. • Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary. • The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the standard scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

**$47.50 NET**

Superior's New Model TV-12 TRANS-CONDUCTANCE

## TUBE TESTER

ALSO TESTS TRANSISTORS!

### TESTING TUBES

• Employs improved TRANS-CONDUCTANCE circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

• NEW LINE VOLTAGE ADJUSTING SYSTEM: A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

• SAFETY BUTTON—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

• NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY: Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

### TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

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We invite you to try before you buy any of the models described on this and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

## NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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Superior's New Model **76**

# For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

IT'S A
## CONDENSER BRIDGE
with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A
## RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms

IT'S A
## SIGNAL TRACER
which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A
## TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

SPECIFICATIONS

### ✔ RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R.C. combination is part of an R.C. bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

### ✔ CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

### ✔ SIGNAL TRACER SECTION
A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

### ✔ TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

**Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy. Only** **$26.95 NET**

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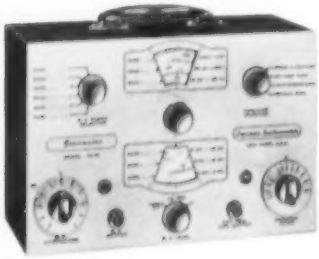

Superior's New Model TV-50

# GENOMETER

**A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:**

**A. M. Radio • F. M. Radio • Amplifiers • Black and White TV • Color TV**

**7 Signal Generators in One!**
- ✔ R.F. Signal Generator for A.M.
- ✔ R.F. Signal Generator for F.M.
- ✔ Audio Frequency Generator
- ✔ Bar Generator
- ✔ Cross Hatch Generator
- ✔ Color Dot Pattern Generator
- ✔ Marker Generator

**R. F. SIGNAL GENERATOR:** Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

**VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

**BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

**MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

**CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

**DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only **$47.50 NET**

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SEE OTHER SIDE!

◀ Cut out and mail TODAY!

(*Continued from page 86*)

inch TV set was used to prove the end results.

The best picture ever received in Cleverdale was obtained. It was sharp both night and day, with no snow or ghosts. The only interference noted was slight and due to motorboats or cars in the vicinity. The picture was equivalent to that obtained from a set operating with usual antenna equipment in a zone where the field intensity was about 1,000 $\mu$v per meter or better.

Generally, the gain of a good rhomboid will be of the order of 20 db and the frequency range will be from 0.5 to 1.5 times the design center frequency with but a few db dropoff at these points. This makes the rhombic antenna the perfect TV antenna when it can be accommodated physically and there is only one direction to consider.

The physical dimensions of the antenna are given in Fig. 1. This is a plan view, looking down from overhead toward the ground. The construction was light as the antenna was to be used in July and August. The wire used was No. 18 solid copper. The two insulators were small Isolantite strain types. The line and terminating couplings were built for the occasion; details for these are shown in Figs. 2-a and 2-b. The transmission line is the usual 300-ohm ribbon type and drops down to the camp.

The line coupling (Fig. 2-a) contains a line-matching autotransformer which steps the 800-ohm antenna impedance down to 300 ohms to match the 300-ohm ribbon line. A coil with 10 turns of No. 14 tinned copper wire, air-supported but initially formed on a $\frac{3}{8}$-inch-diameter rod, was pulled until it opened uniformly to a length of about $1\frac{1}{4}$ inches. Taps were then soldered two turns from each end as shown in Fig. 2-a. The stepdown of 10 to 6 turns gave the correct turns ratio with a coupling coefficient of 1 to give an impedance ratio of 800 to 300 ohms. This was prechecked by connecting an 820-ohm resistor across the 10 turns and measuring the impedance across the 6 turns with an rf resistance meter.

The bases of the couplings were made of a good grade of natural-color, paper-base, rf-grade insulating compound, about $\frac{1}{4}$ inch thick. The 300-ohm line clamp bar was made of the same material. Although the impedance levels are low, it is well to use good material, for these units become wet when it rains. Where installations are to be permanent, it is advisable to dip the couplings into a bath of rf-grade Zophar wax for waterproofing. Manufacturers furnish, on request, data on temperature points, hydroscopic and rf characteristics for their waxes.

All screws, washers and nuts used were cadminum-plated brass and had 8-32 threads. No. 8 lugs were used to anchor the coil to the screws. The terminating coupling (Fig. 2-b) contains only the 820-ohm terminating resistor. A 2-watt unit was used although


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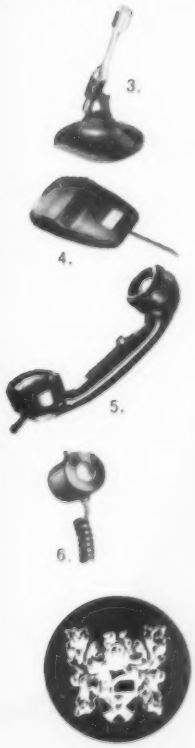


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3. D22 Dynamic Omni-Directional Microphone is a beauty queen—and dependable too. Quickly converts to hand use.

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6. A mobile microphone that resists moisture. Ideal for ship-to-shore and aircraft installation. High output, shock resistance.

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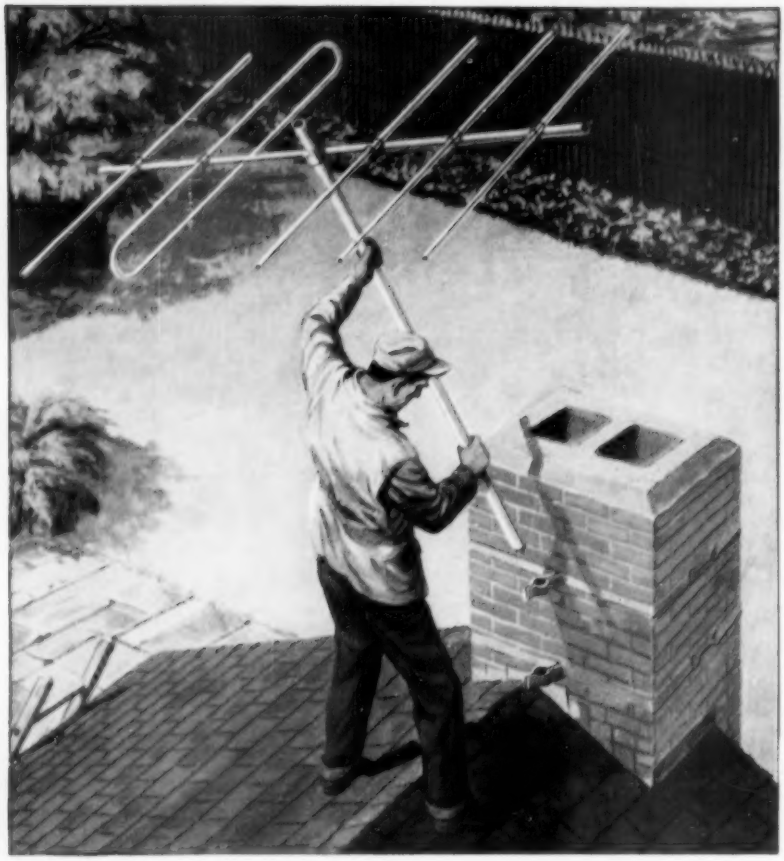

**sturdy, steel PERMA-TUBE lasts three times longer than galvanized TV masting**

Resistance to bending in Perma-Tube TV masts is greater than in galvanized masting. Perma-Tube's extra resistance to bending and damage by wind-force protects your reputation and improves TV reception.

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Perma-Tube is corrosion-proof. It is treated with vinsynite—then coated with a metallic vinyl resin base both *inside and outside*. It successfully passes ASTM's 500-hour minimum salt spray test—which guarantees longer life under corrosive conditions.

Five diameters of fitted joint Perma-Tube are available, ranging from 2½" OD to 1¼" OD. Telescoping masts can also be erected up to 50 feet high, using 10 foot lengths of high strength J&L 16-gage Perma-Tube.

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**Jones & Laughlin STEEL . . . a great name in steel**



it might be better to employ a higher-wattage resistor for durability and to withstand better the transients that might build up due to electric storms. In any event this resistor should be as nonreactive as possible.

The halyards or tie ropes can be of wire strung through rubber tubing and wound around the trees to prevent evenual biting into the trees and thus injuring them. Since the installation in this instance was for a 2-month period only, the ties to the trees were made with discarded cords from venetian blinds (discarded because they had become unsightly, but still mechanically strong). It is advisable not to tie the diamond too tightly but to leave some slack to allow for tree sway. Incidentally, no detrimental effects on reception, either electric or mechanical, were noticed due to trees swaying in high winds. The diamond configuration is unusually elastic due to its shape. It should be an ideal jungle antenna!

However, the termination coupling must always point in the direction of the chief station desired. In this instance the termination coupling was to the south and the line coupling to the north. WRGB is south of Cleverdale.

### The uhf rhomboid

The uhf rhombic antenna can be built as a one-piece assembly on a couple of crossed spars as shown in Fig. 3. A 2-wavelength rhombic antenna to operate from 470 to 890 mc was built for operation in Schenectady to receive WMGT, Mt. Greylock, Mass. (channel 71); WCDA, Albany, N. Y. (channel 41); WTRI, Troy, N. Y. (channel 35).

The construction is electrically similar to the large antenna for the vhf band. The couplings are screwed to the ends of the longest spar. The unit works out to be about 5 feet long and over a yard wide as shown in Fig. 3. By attaching some gusset plates of marine plywood at the center, couplings for antenna rotors may be attached. Since the stations listed were all substantially east of Schenectady, the assembly did not have to be rotated.

The line-coupling transformer again has 10 turns with taps 2 turns from each end for the 6-turn secondary match to 300-ohm round line as used for uhf reception. In this case, however, the coil is formed on a rod ¼ inch in diameter. The unit is a 2-wavelength rhomboid centering at 680 mc, the mid-frequency of the uhf band. The wave angle becomes lower the higher it is placed above ground. Fig. 3 is a plan view, looking down on the antenna. Again, the resistor used at the terminating end must be nonreactive and the resistor end is oriented toward the station wanted.

This antenna gave results equal to or better than the most expensive antennas available commercially. Such rhomboids can be stacked for transmission or reception but physical relations have yet not been determined. END

# RCA *Custom Convertible* SPEAKER SYSTEMS

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**RCA 501S1 Biaxial Speaker**—compares with models two or three times the price! Features 14.5 ounce Alnico-V magnet and 8-ohm voice coil. Its 12-inch woofer employs

Olson-developed foam damping ring; 3-inch tweeter is mounted off-axis to minimize crossover interference; high frequency response extends beyond 18,000 cps.

**Suggested User Price (optional) $33.50**

**RCA 502S1 Direct Radiator Speaker**—outstandingly smooth, unsurpassed in its frequency range to 16,000 cps. Features same construction as 501S1 and incorporates

medium-weight curved cone for smoothness, range, damping, and sensitivity to equal sound pressure of higher power speakers using double the power input.

**Suggested User Price (optional) $25.25**

**RCA Enclosures**—Beauty in cherry or blonde cabinetry, the *solid Honduras Mahogany* will enhance room decor with the expensive look and feel of fine woods. Built for a lifetime of use, RCA enclosures feature mortise-and-tenon joints, glue-block

reinforcements and wood-screw clamping. For 12-inch speakers.

**Suggested User Price (optional)** 300W1 Cherry **$69.95** 301W1 Blonde **$74.50**

**301X1 Adapter Panel**—converts 12-inch enclosures for use with 8-inch speakers.

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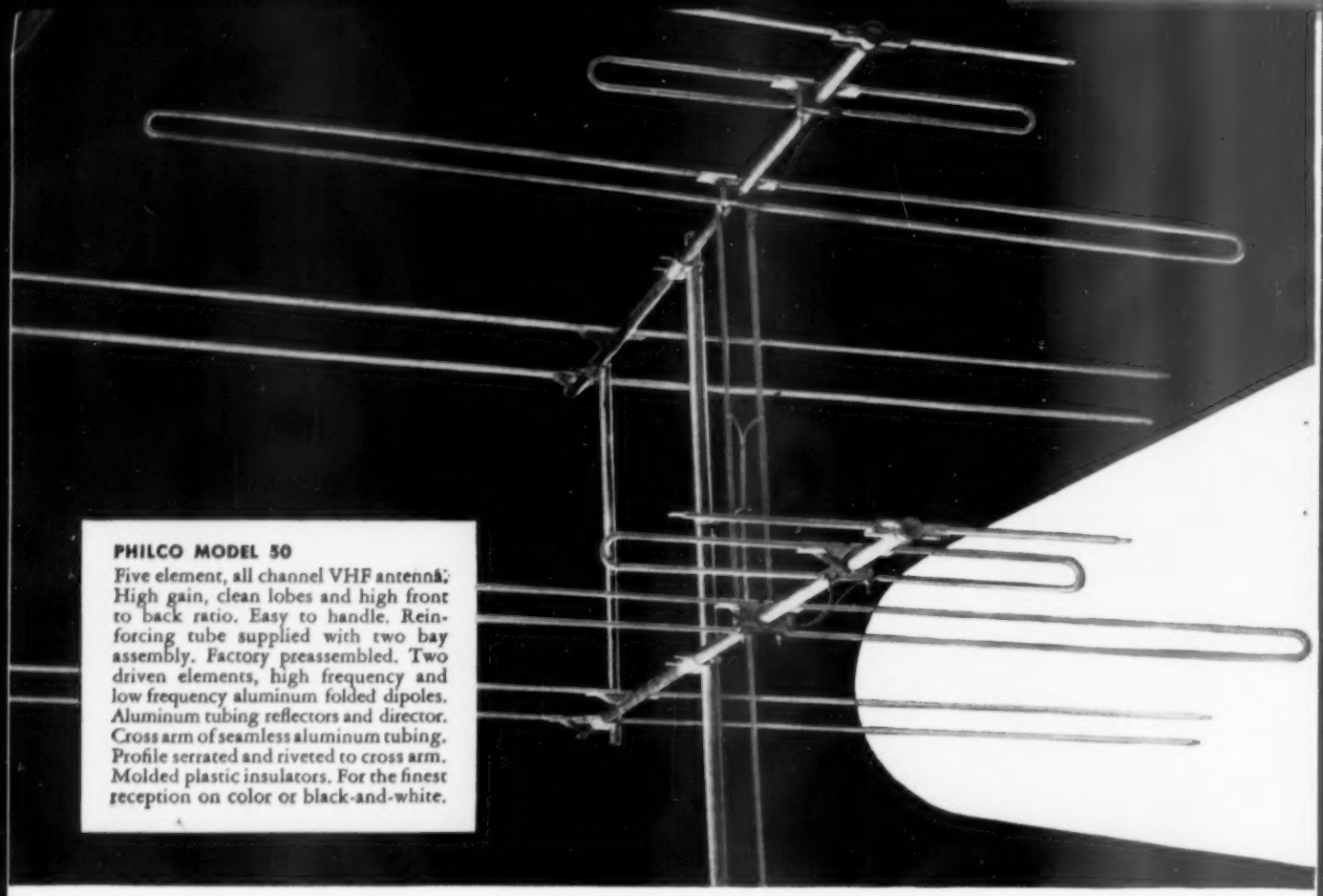
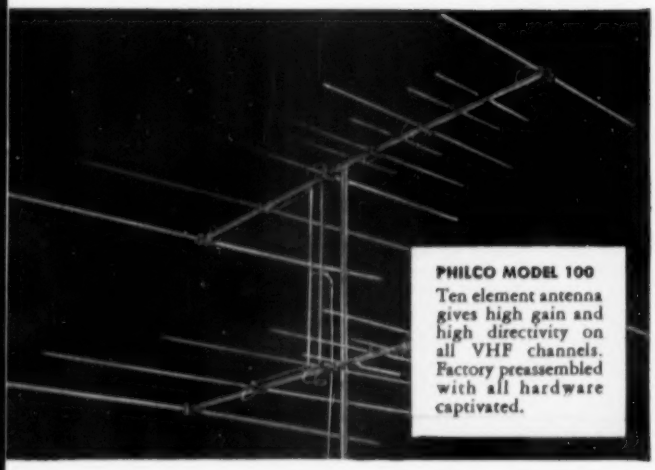


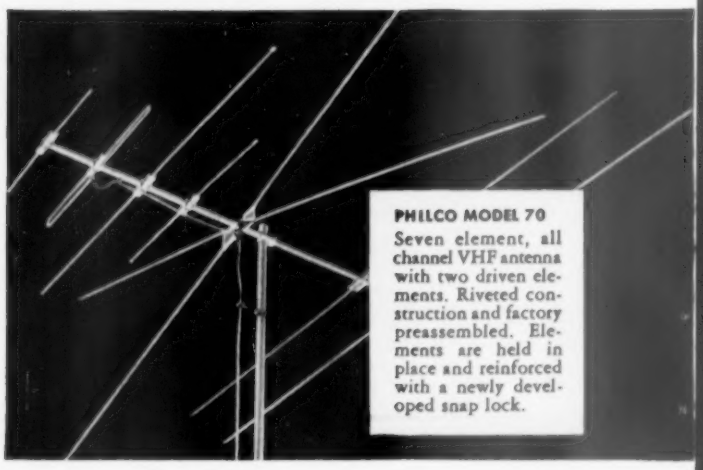
**PHILCO MODEL 50**

Five element, all channel VHF antenna. High gain, clean lobes and high front to back ratio. Easy to handle. Reinforcing tube supplied with two bay assembly. Factory preassembled. Two driven elements, high frequency and low frequency aluminum folded dipoles. Aluminum tubing reflectors and director. Cross arm of seamless aluminum tubing. Profile serrated and riveted to cross arm. Molded plastic insulators. For the finest reception on color or black-and-white.



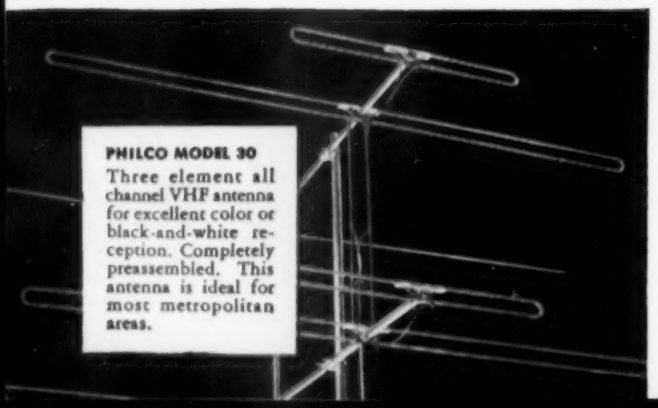
**PHILCO MODEL 100**

Ten element antenna gives high gain and high directivity on all VHF channels. Factory preassembled with all hardware captivated.



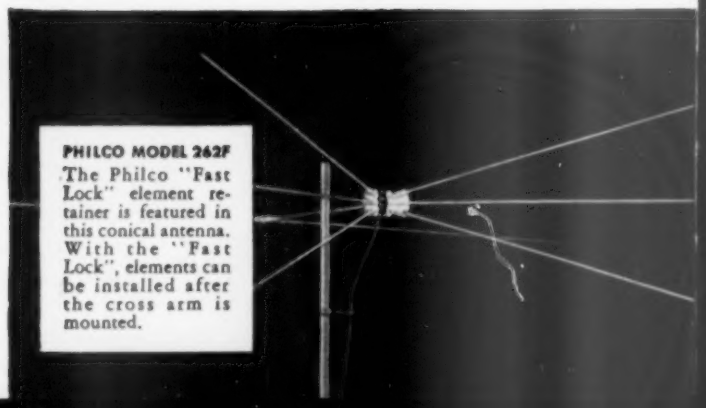
**PHILCO MODEL 70**

Seven element, all channel VHF antenna with two driven elements. Riveted construction and factory preassembled. Elements are held in place and reinforced with a newly developed snap lock.



**PHILCO MODEL 30**

Three element all channel VHF antenna for excellent color or black-and-white reception. Completely preassembled. This antenna is ideal for most metropolitan areas.

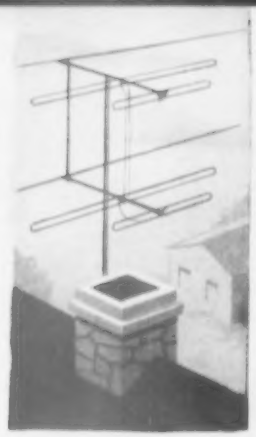


**PHILCO MODEL 262F**

The Philco "Fast Lock" element retainer is featured in this conical antenna. With the "Fast Lock", elements can be installed after the cross arm is mounted.

*Mr. Service Dealer*

# BIG NEWS *from* PHILCO!



## Fringe tested, color tested TV Antennas, now at volume prices!

**Give picture power equal to antennas priced two to three times higher. Compare!** Now, Philco brings you a complete line of quality antennas with a wide range of models to give outstanding performance over the entire VHF range. These antennas were designed and engineered to reproduce the best pictures whether in strong signal areas or far out into the fringe and whether receiving a picture in color or black and white. In many locations you can give your customers stations they never received before. Field and laboratory comparison tests conducted under the most exacting circumstances on actual on-the-air programs give you the complete insurance that you can always sell Philco antennas with complete confidence in any TV area.

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**P11 CONTROL**
Manually operated antenna rotor that will easily handle two bays. Designed for years of dependable service. Fits masts up to 1⅝" diameter.

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A heavy duty rotor. Accurate direction control provided by manually operated motor switch and indicator meter. Plastic cabinet of modern design.

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Heavy duty, long-life automatic rotor with new automatic control unit providing dependable and fool proof operation. Also available as AP1.

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**AP1**
**Rotor**

**P4A**
**AP22**
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RE-557

# Locating intermittents

*Equipment and techniques necessary for finding those really tough ones*

By PAUL BOLLER

OF all TV troubles, the intermittent type is most feared and cursed by all technicians. Home repairs are nearly impossible. In the shop, bench and equipment may be tied up for hours while the trouble refuses to show up. This often wrecks technicians' nerves and disgusts customers left waiting. One of these customers would be quite disturbed if he received a truthful bill for:

| | |
|---|---|
| 1 capacitor | $ .25 |
| labor | 25.00 |

Is there a way to help these people? Yes! Time being the most expensive item, we have to trim it down drastically. Intermittent as a set may be, it uses the same circuits as a normally operating chassis. Nothing mysterious there. As on the conventional repair job, we have to localize the trouble to a section or two and then *produce it at will*. I agree that the task of locating a faulty circuit may be most difficult when we consider all the new trick circuits, of which many bite their own tail: Is insufficient horizontal drive due to poor B boost which furnishes the horizontal oscillator's plate voltage or is the insufficient B boost due to the lack of drive? Is i.f. overload due to reduced a.g.c., or is the loss of a.g.c. due to clipping in the overloaded i.f.? If these problems are intermittent as well, you really have troubles.

"Test" equipment for locating intermittents.

For efficient servicing a system has to be adopted. So let's not sit there staring at the chassis, probing it, wasting precious time pulling on this and wiggling that. A careful visual inspection usually reveals a few loose nuts, poor connections, overheated parts, near shorts, etc., sometimes related to the trouble. It always pays to take a good look at the wiring.

## Causes of intermittents

Only while the trouble is present is servicing possible. So we have to cut out normal-operation time. We have to force the trouble to be there most, if not all, the time. Therein lies the secret of successful intermittent repair. To change an intermittent into a permanent defect we have to know which conditions cause intermittent breakdowns. They are the same as those causing permanent defects.

1. *Mechanical.* Loose connections, near shorts and near opens, poor contacts, poor soldering, intermittently open capacitors and microphonics are usually due to mechanical causes.

2. *Thermal.* Heat expansion makes shorts from near shorts and opens from near opens. It increases leakage in capacitors and changes the value of composition resistors. It increases the resistance of transformer windings, thereby reducing their efficiency and sometimes causing shorts. High temperature increases the losses in selenium rectifiers, filter capacitors and certain dielectrics. In tubes, excessive heat causes release of gas and grid emission through deposits of cathode material on the grid winding. Grid current in some cases can completely upset circuit operation because of incorrect bias.

3. *Voltage.* Reduced or increased voltages, unstable lines, etc., usually affect the sweeps. Low voltages lead to dead or off-frequency v.h.f. oscillators. High voltages accelerate breakdowns through increased electrical stresses and higher temperatures. Excessive B plus and bias voltage variations due to thermal causes in one circuit may upset the operation of another.

4. *Climatic conditions.* Excessive summer heat increases chances for thermal breakdowns. High humidity reduces insulation resistances, increases the values of composition resistors, causes corona, arcs, electrolysis, etc. Electrolysis usually can be detected by the resulting corrosion. Watch for tarnished areas on the chassis near conductors carrying high voltages. Breakdown usually occurs in or near these.

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## TELEVISION

### Producing breakdowns

Having named the four most frequent causes of breakdowns, let's see what we need to produce these conditions on our bench:

*Mechanical:* A thin fiber rod 8 or 10 inches long. Pointed at one end, with a wedge-shaped slit at the other, it can be used to pry, tap and move wires and components. Metal is not recommended because of danger of shock, shorts and capacitance effects. The latter often are great enough to restore operation of a critical circuit to normal. Thus, scope and meter leads should be connected to the wiring before trouble-shooting. Keep in mind, however, that even a fiber prod may cause noticeable detuning if brought near circuits operating at TV front-end frequencies. This is due to its dielectric factor, which is four to six times higher than air.

A rubber hammer made of a big eraser with a ¼-inch or thicker fiber rod as handle. The use is obvious. It is safer and more substantial than a tube tapper which is often made from a pencil with an eraser mounted hammer-fashion on the rear end.

This gadget should not be used on high-voltage circuits, as a few good jolts will soon convince anyone who makes the attempt. After some personal experience along that line, a few measurements and tests seemed in order. It may come as a surprise: 16 kv can jump through the wood and eraser without trouble. The resistance of the graphite from end to end on a new pencil is less than 30 ohms. The insulation resistance of the wood, from outside to graphite, on a damp summer day is usually below 100 megohms.

*Thermal:* A 250-watt infra-red lamp with a suitable stand and a ceramic socket is used to heat parts once the intermittent circuit has been located. Dark components heat faster than light ones. An easy way to limit the infrared radiation to a few suspected parts is to stick a white sheet of paper to the chassis, masking the circuit. Then cut holes to expose the parts to receive radiation.

A small fan, used with the infrared lamp, reduces the length of the warmup–cooloff cycles. Cardboard boxes of the type used to ship TV table models make ideal hoods when the entire chassis has to be heated. A few small holes should be cut to permit observation of the screen without lifting the hood.

*Voltage:* A commercial variable transformer allows the reproduction of low and high line conditions. Sudden drops and surges can be created by switching on and off some heavy load (1 kw or so) connected to the same outlet. This load may be a hotplate, an iron, etc. If no such appliance is available, a smaller load (250-watt heat lamp or soldering gun) connected to the secondary of the variable transformer, and thus in parallel with the set, will do the same job. Some old and worn rectifier tubes of the common types are sure-fire producers of low B plus.

*Climatic:* A small plunger in a can of water or a cheap vaporizer placed under a hood with the set will soon raise the relative humidity to near 100%. Corona and leakage can be induced in most cases without trouble and in a relatively short time.

Using our head and these real time-savers, we can outrun any so-called technician who lets the chassis cook on the corner of the bench. If and when the trouble finally shows up, he may discover that the mere contact of his v.t.v.m. probe to the suspected stage restores normal operation for several more hours. Because nearly 80% of all intermittents are of a thermal nature, it is nearly useless to run an open chassis on the bench because it never reaches its normal operating temperature.

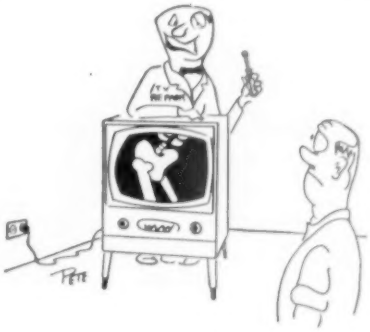
### The customer angle

There will always be hopeless cases which defy all treatments. But with our systematic approach, we can reduce their number. The best method of billing for the real tough jobs is a detailed statement, even if it takes a half-hour to set it up. Itemize every test, with respective time and corresponding charge. This will usually impress the customer and restore any lost confidence. He will realize what it takes to trace and correct an obscure intermittent, even with the most modern equipment and methods.

Do not make the mistake of letting off your steam over the tough job on the customer. He is innocent and will resent it. If he is guilty—because he may have diddled the set, don't blow your stack—be nice. Remember that he feels like a victim and may need sympathy.

If you take him through the shop, show him the equipment, the manuals and the parts stock, you may immunize him against the flood of "fix-it-yourself" propaganda.

Once you have the reputation of being a whiz on dogs, you need no longer worry. Your success as a technician is assured. You will find a particular pride and satisfaction in grabbing the jobs which other technicians back away from. END



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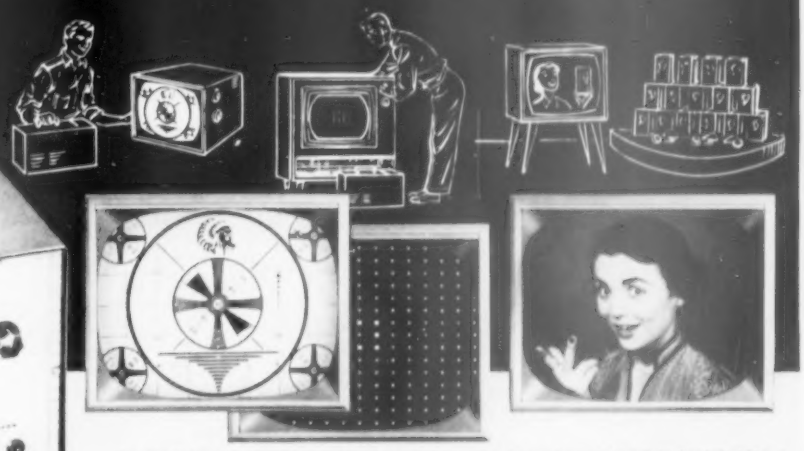

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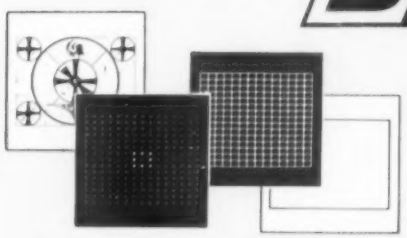

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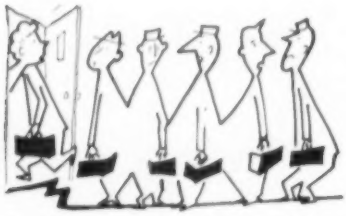
# CUSTOMERS WE COULD DO WITHOUT

*As if the sets aren't tough enough, here's more to contend with*

By ART MARGOLIS

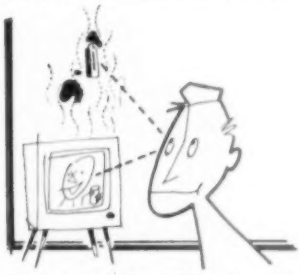
THE voice on the telephone told me politely, "You people are the fourth television company I have just called. The first one to arrive may fix the set."

I patiently explained that, although our service technicians are all healthy, we as a TV repair group could hardly be considered a track team and, even though our gayly painted trucks read "Fast Service," they would never stand the gaff of a hot-rod race. I remained as courteous as any maneuvering diplomat because I was grateful. At least she sounded the call to arms and I was happily spared unnecessary expense. Occasionally though, we are duped. A call will come in, a high-salaried television expert dispatched to a cross-city destination, only to find a large group of technicians standing in front of a customer's home like a bunch of disgruntled tourists turned away from the box office of a hit show on Broadway.



Besides a hair-pulling effect on morale, these tricks cost us TV service operators a lot of money. The usual practice of TV repair outfits is to figure out a flat minimum fee for a house call. This is computed to cover: receiving the call by a trained telephone secretary, dispatching the call to a technician, his car expense, driving time, overhead, labor time in the home and, we hope, a fair profit. This amount is commonly known as the service charge. In addition to the service charge there is added the list price of any parts that may be used in the repair. It is the usual thing to collect the minimum fee each and every time a house call is made, whether the repair is simple or complex, completed or what. The customer is obligated to pay this service charge as long as she places a call and a technician comes to her dwelling.

However, I was out on a call a few weeks ago. The house was located in an older section of town. I could see signs of action of a home-remodeling firm in the neighborhood. Lots of the houses were decked out with new door fronts, neat brick pointing and shiny storm-window installations. I entered my assigned residence and, after exchanging the usual banalities, I heard a sentence uttered. I've been on thousands of TV repair calls but I never heard this one before. Matter-of-factly she said, "Every time I turn on the television set the house gets cold." I looked at her closely for signs of alcoholism or possibly dementia, but she was cold sober and perfectly rational. Shrugging my shoulders I began my investigation. Good fortune was smiling because I located the trouble immediately. She was right. With the help of her husband I moved the television to the other side of the room and the house began to warm up. It seems my customer had her 40-year-old coal heater replaced with an oil burner. The thermostat had been installed directly over the TV receiver and, when the set was operating, the heat generated by its 25 tubes kept the thermostat above the temperature which would have activated the heater. I was quite thrilled at the ease of the unique repair but my unsmiling patron was only annoyed at having the set on the wrong side of the room. She wanted me to do something so she could keep it where it had been. I told her the only possible way would be to relocate the thermostat. Her expression then changed and I thought that perhaps she had taken a drag on a lemon. The final blow came when I handed her a bill for the minimum service charge.



She remarked, "You didn't do anything to the television set. I'm not going to pay you."

When I persisted in trying to collect, her husband made a few menacing gestures, so, putting discretion above valor, I left. The windup was I didn't collect the bill till the constable went around there. At least the constable didn't have to make a special trip though; he collected for me at the same time he collected for the oil burner.

In roughly one out of every four calls we find the repair cannot be made in the house. Special testing is required. Just as the doctor gives pills at home for the grippe but must send you to the hospital for an ulcer removal, so our TV technicians can change tubes in the house but takes the receiver to the shop for more serious surgery.

### The hard-luck story

I was about to deliver a chassis that had just been reincarnated in our shop. I wouldn't want to say flatly that

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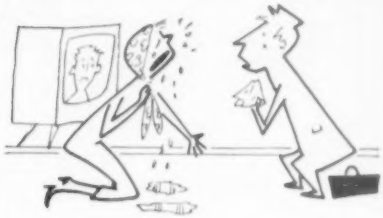
some novice had been toying with it but the tubes in wrong sockets, sliced-up tuner coils and wires on places where they could do the most harm did indicate previous inexperienced labor. Upon arrival at the customer's abode, I received a cheery hello. But evidently my customer mistook me for a social worker because all the while I was installing the chassis I was told of the death of her mother and the funeral expenses, her husband's un-



employment and the subsequent lack of funds, her recent gall-stone operation and its high cost, her elder son's struggle for education and how it was strapping them financially and other such money tappers. By the time I completed the installation, I was deeply touched by her poverty but the thick rugs and large-screen three-way combination receiver enabled me to hold back the tears. Steeling myself with reminders of the mouths I had to feed, I handed her the bill. She evidently had forgotten the estimate the technician had given her and the telephone call I made prior to delivery for when I informed her of the price she had a heavy emotional shock.

First I was told that the money would be mailed to us. Upon reminding her of our COD policy, I was offered 50% of the tab. When I refused the offer, a gleam came into my patron's eyes and she began to examine the set. I wish our bench technicians could have seen her for her detailed perusal was done in magnificent style. She found trouble that I never dreamed could exist. In fact, the troubles she found were so well hidden I was unable to see them. With these as reference, she then sternly told me the repair was not perfect and she would not pay the full price. I remained calm but still demanded full payment. She relented and offered me a post-dated check. Politely refusing, I stood my ground. Finally, she disappeared upstairs and, after the creaking of a mattress, returned with cash. Seeing the green stuff, I gave way and laid out the 1% sales tax from my own pocket.

### Beating out the technician

Insurance companies have been complaining for some time about people who feel conscience-free in putting something over on them. The beating of insurance companies has become a great game. But since TV a new project has been added to this type of diversion—outwitting the TV service technician.

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## TELEVISION

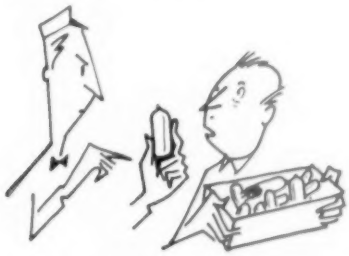
I was doing a call the other day and after about 45 minutes of toil I located three bad tubes. Then I saw that the picture had been horribly distorted by someone's monkeying with the adjustments. Another 20 minutes more of work had it perking along nicely. The customer apologized and mentioned he worked in the shipping room of a nearby set manufacturer and felt this experience enabled him to fix his set. I stood up, pulled out the receipt book and began to make up the tab.

"Hold on there, fella," I was told, and the set owner disappeared into the basement. He came up presently with a long thin box and I thought he had brought me a bottle of champagne to toast my success. But the box contained only tubes. "How about taking your tubes out, fella, and putting mine in," he said in a pleasant tone.

For some reason, at that point, I remembered a piece in the newspaper that told of television tubes being stolen from a local TV manufacturer.

Joining in the spirit of things, I said in an even more pleasant tone, "No." Then, thinking that I should share in the fun even more, I picked up a tube from his box, scrutinized it carefully and said in my best suspicion-filled voice, "Where did you get these?"

That did the trick for he flushed and replied, "Oh, it's OK, leave yours



in." With that he snatched the tubes from my hand and hurriedly departed back into the basement with the full box. He came back up fast and, with a few beads of perspiration on his forehead, paid my bill plus a dollar tip. I could see him breathe deeply in relief as I closed the door behind me.

On all repairs we give at least a 90-day guarantee. Since the average television receiver contains nearly 2,000 parts and connections, this guarantee must have some limits. Therefore we specify that any parts we may replace are guaranteed against defect for 90 days. Also, we supply any labor that is necessary to change these defective parts. That is the limit of the guarantee, although we often are forced to go much further to make a disgruntled customer happy. Sometimes, however, they want a bit more than we can supply.

We did an expensive repair job on a 16-inch Olympic table model. A few months after delivery of this set we received a phone call from the same

(*Continued on page* 104)

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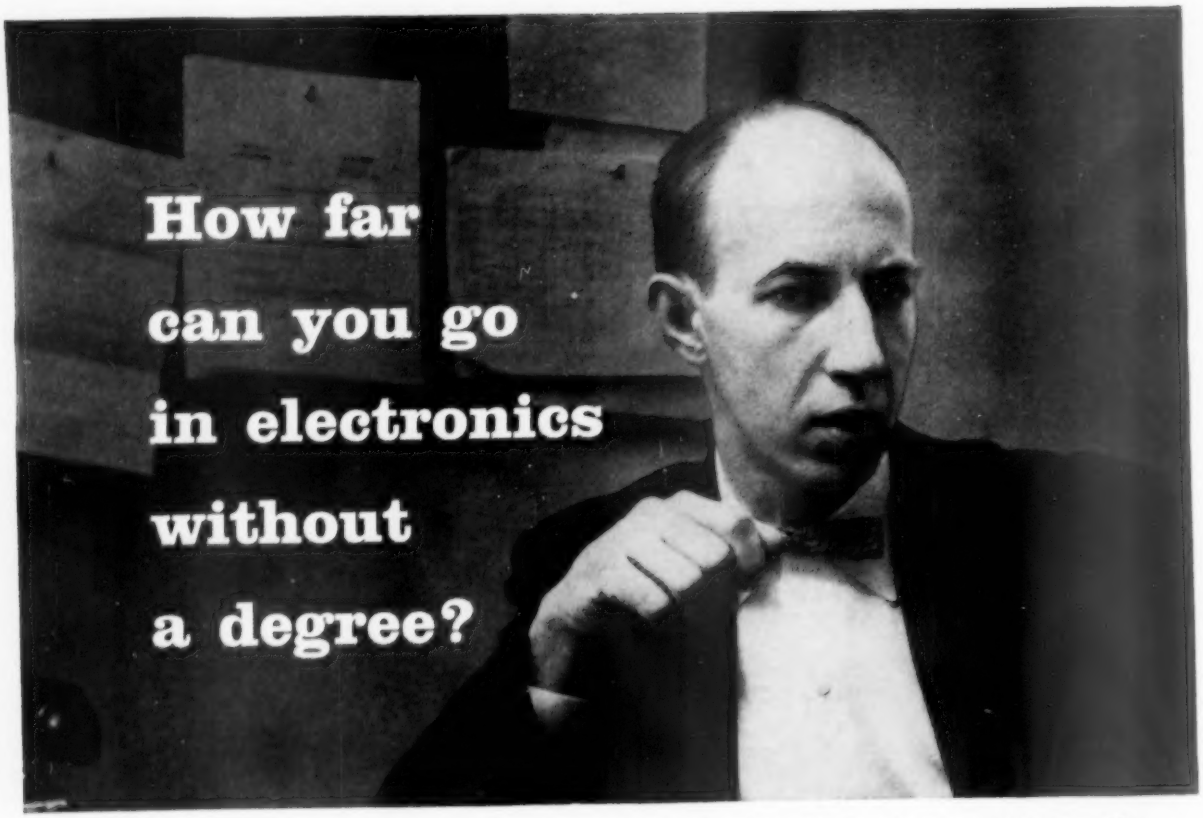


Bill Miles talks frankly about the technicians' biggest problem

2 years ago, degreeless Bill Miles had reached a blind alley in his career. Yet today, with IBM, he's actually supervising engineers in America's biggest electronics project. Here's how this technician broke through the "education barrier."

"*Training* and *local assignments*," recalls Bill Miles, "were what caught my eye when I saw an IBM ad in 1955. So I investigated. Now here I am with an advanced electronics education under my belt—and responsibility as a Group Supervisor in Project Sage. I work on the world's largest and most advanced computer. I live in my home town. And my future in the company is what I make it. Yet only 2 years ago, I thought I'd gone as far as a technician ever could!"

### Becomes radar technician

Bill's background is typical of thousands of capable, ambitious technicians who never acquired a formal engineering degree. His interest in electronics, aroused in Camden, New Jersey, high school, was nourished by a 3-year stint as Aviation Radar Technician in the Navy's "Black Cat" air-sea rescue squadron.

### Takes night courses

Discharged in 1946, Bill married a girl he'd known in high school. During the next 9 years, Bill was teacher in a radio-TV institute, TV service man, TV company technician, and chief supervisory TV technician. All the while he pursued an engineering education at night. But growing family responsibilities made it more and more difficult.

### Finds doors barred

However, feeling he was equipped for greater responsibility, Bill, now 30, investigated several companies but found that, while they liked his abilities, his lack of degree barred the door to any significant future advancement.

### Enters IBM school

In May 1955, when he moved his family to Kingston, New York, and started at IBM, Bill wasn't quite sure what to expect. The 9-month training course—valued at many thousands of dollars per man—had been the big magnet for him. He hoped the future would match his expectations.

### Meets head of school

"Sixty of us started school at IBM, attending class 8 hours a day. The course consisted of about 20 subjects, mostly dealing with computer circuits and units, and maintenance techniques. The teaching was adult, superb. After the first 20 weeks, we received a living expense allowance, over and above salary. We kept our own grades, and every 6 weeks when we reviewed them with the instructors, *they* asked *us* for ways to improve the course. I expected a casual 'hello' when I met the Division Manager of Education, but he talked to me for an hour about myself and my interests. The real concern IBM has for you as an individual, both before and after they hire you, is undoubtedly one reason why we all began to take a lot of pride in this outfit."

### Joins home-town computer site

Bill had joined IBM as a Field Systems Engineer. After graduation, when 10 of his classmates were immediately promoted to specialized assignments, Bill was assigned to a computer site near his home in Mt. Holly, New Jersey, with IBM paying his moving expenses. For the first two months he helped install the SAGE computer, an important link in America's air defense. Ultimately, such computers will ring America's entire air defense perimeter. Looking back, Bill notes, "I'll admit the work was laborious and difficult, but still I have a sense of great accomplishment. Together we all helped create something of value from almost nothing."

## World's largest computer

"The computer is probably the largest one in the world, with over a million components. Flattened out, it would probably fill a ball field. The computer analyzes radar data on every object in the sky. Then it checks each object against available traffic information and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against what it thinks is a 'baddie.' Only airmen can make that decision."

Bill gets electronic computer education at IBM Kingston

## Supervises fifteen

Recently promoted to Group Supervisor, Bill now directs an entire shift of 15 men, reporting to a Group Manager. His job: to maintain the computer in combat readiness. "I have to be familiar with the entire system. I rely on two types of specialists to help me: computer units men who are specialists in certain areas; systems engineers for the over-all computer."

Miles does diagnostic programming on the Operating Console of the Sage Computer

Miles nails down problem with Site Manager R. Schimmel

## Buys house, car

Bill has bought a 7-room house in Mt. Holly. When not busy with his son and twin daughters, he likes to bowl. He drives a new automobile. He's enjoying the good life, and expects it to get even better. His employee benefits alone represent a cash value of many hundred dollars a year. He expects the IBM-sponsored General Education Program will prepare him for higher management responsibilities. Later, Bill's manager said, "He's currently assuming the responsibilities of an electrical engineer."

But the question remains: Is Bill really an engineer?

## The "professional" engineer

"No, I certainly don't consider myself a 'professional' engineer, qualified to design machines, for instance. But the point is, I'm doing work ordinarily done by engineers . . . work usually denied to men without a degree."

## IBM upgrades technicians

Could he do this elsewhere? "Of all the companies I know, IBM appears to be one of the few upgrading the technician to the level of engineering responsibility. Fortunately for me, IBM had the imagination to get men without degrees and encourage them to rise in responsibility and income to the level of their native talents . . . not what their formal education dictates."

"Student" Bill Miles diagrams computer circuit

## Both titles gain

Is this a sign that the educational system is wrong? "Not at all," answers Bill Miles. "A Doctor's, a Master's, a B.S. degree stand for something and always will. But if a technician can perform many jobs that traditionally belong to the engineer, they both stand to gain. The technician, because he gets much of the engineer's salary, satisfaction and recognition; the engineer, because he is free to do work which *only* a man with his formal training can do. When everybody wins, and nobody loses, it's the sign of a good thing."

Since Bill Miles joined IBM, opportunities in the Project Sage program, destined for long-range national importance, have grown more promising than ever. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, as a Computer *Systems Engineer*. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training, as a Computer *Units Field Engineer*, with opportunity to assume full engineering responsibility. Assignment in area of your choice. Every channel of advancement in entire company open—and IBM is leader in a field that's sky-rocketing in growth. All the customary benefits and more. WRITE to Nelson O. Heyer, Room No. 3105, IBM, Kingston, New York. You'll receive a prompt reply.

Home-town assignment pleased Miles' wife, son, twin girls

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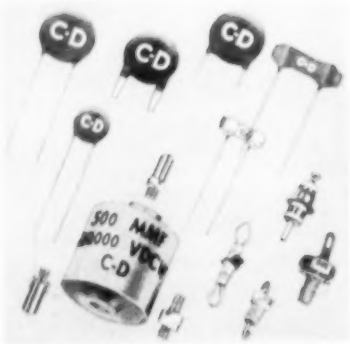


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## TELEVISION

(*Continued from page* 100)

house. Upon admittance I was led into the parlor and reminded politely of the guarantee we had placed on the set. There sitting on a table, and I remembered the table due to its odd triangular shape, was the Olympic table model. Confidently I reached for the on-off switch and turned, but I heard no click. Upon closer scrutiny I saw I was stupidly holding the vertical control. Then I noticed this was a 16-inch Olympic but it was a different model and year. The controls on this model were in different places than the other model. I courteously asked my customer whose set it was. With flushed cheeks it all came back to her. This was her brother's set that he brought over and the one we repaired was upstairs in the bedroom. Stammering slightly, she giggled, "Isn't that a funny one?"

I smiled back, "Yes, it is."

We had a 19-inch RCA chassis in the shop (left the tube in the cabinet in the home) that took a tuner repair and complete if alignment. A few days after delivery I was called out on a follow-up summons on this repair job. The man of the house opened the door for me and led me to a basement den. Then in a loud voice, like a well-rehearsed top sergeant bawling out a recruit, "There is a brown spot on the picture tube. It was not there before you people fixed our set!" A little shaken up from his warm reception, I looked at the spot. It was a skull-and-crossbones ion burn on the phosphor face of the picture tube. My attempts to explain to the customer that it can only occur over a long period of time did nothing but incite rage. He screamed and threatened, "You better put in a new picture tube for me free or else!" I departed from this boiling emotional inferno as rapidly as I could. An odd thing happened a couple of days later at one of the wholesale houses. I met a cronie of mine and, as TV technicians will do, we recounted our outstanding experiences of the immediate past. I started to tell him this one and before I was half done he stopped me, told me the man's name, address and make of set. Then he related a like episode that happened to him with the same man and the same picture tube over a year ago.

I hope I have not given you the opinion that these are typical cases. These histories are not the usual experience the TV technician runs into. The stories I have related are the offensive minority but like all unpleasantness their emotional impact make them stand out like hot pokers in the mind. They are the nasty small group of individuals who don't get along with their neighbors and who are designated in department-store credit lists as poor risks. From the banker to the newsboy they employ their tricks and become known for them. They are customers we could do without. END

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# TV Service CLINIC

conducted by
JERRY KASS

ON most channels the video carrier of a television signal is only 1.5 mc higher in frequency than the sound carrier of the channel below it. Similarly, the sound carrier of a TV signal is only 1.5 mc below the video carrier of the station above it. Thus, the broadly tuned rf circuits of TV tuners provide little protection against strong adjacent-channel interference. Of the two possibilities for this type of interference the lower-channel sound is the most bothersome, producing a visible beat in the picture that varies with the audio modulation. This will often occur when a receiver is tuned to a fringe signal of perhaps 100 μv while the adjacent-channel signal produced by a local station is picked up at a powerful 50,000 μv.

This problem can be attacked from several angles, including antenna orientation (favoring the desired signal), changing the height or location of the antenna, using an antenna with a good front-to-back or front-to-side ratio, adjusting the if response curve and tuning or adding adjacent-channel traps.

A simple, efficient method of attenuating these and other undesired signals is to use a stub. This is nothing more than a short length of transmission line connected to the antenna terminals of the receiver, in parallel with the antenna lead-in. Ordinary 300-ohm line can be used and is cut to either a quarter-wavelength with the unconnected end open or half-wavelength with the unconnected end shorted.

A transmission line contains distributed inductance, capacitance and resistance, the ingredients of a tuned circuit. Fig. 1 shows open and shorted transmission-line sections, two are a quarter-wavelength and two are half-wavelength. The open end is a point of minimum current, maximum voltage and thus maximum impedance. The shorted end is a point of maximum current, minimum voltage and therefore minimum impedance. Each quarter-wavelength back from the end of the line the voltage and current positions are reversed. Thus, a quarter-wave line at one frequency will have the same characteristics at frequencies where it becomes three-quarter of a wavelength, five-fourths, etc. The generator in Fig. 1 looks into a high impedance with the shorted quarter-wave and the open-ended half-wave lines. It looks into a low impedance with the open-ended quarter-wave and shorted half-wave lines. Suppose we replace the generator with the antenna input terminals of the receiver. The high-impedance stubs act like parallel-resonant circuits across the input terminals with the low-impedance units appearing as series-resonant circuits. Since a series-resonant circuit acts as a virtual short circuit between two points, either an open-ended quarter-wave or shorted half-wave section will bypass an interfering signal while offering higher impedance to the desired signal. The impedance rise off resonance will vary with the Q of the resonant circuit. A section of 300-ohm transmission line represents a relatively high-Q circuit and is very selective.

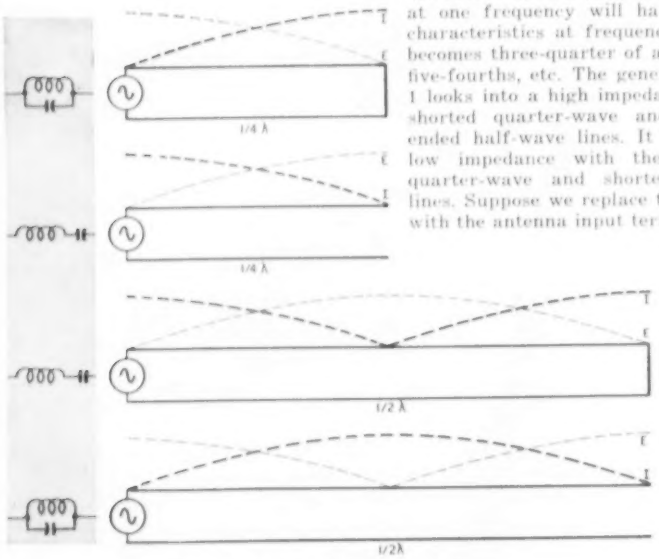


Fig. 1—Transmission line stubs.

The dimensions of the quarter- or half-wave stubs depends upon the frequency to be attenuated and on the type of line used as the stub. Considering frequency alone, the length of a quarter-wave stub in inches is equal to 2,952/f, where f is frequency in megacycles. An important correction factor must be added to this formula, the velocity or propagation factor. Fundamentally, this is the ratio of the velocity of radio waves in a conductor as compared to their velocity in air. In 300-ohm transmission line this factor can be taken as approximately 83%. Thus the formula for a quarter-wave stub becomes

$$\frac{2{,}952 \times 0.83}{f} \text{ or } \frac{2{,}450}{f}$$

For a half-wave stub the length would be twice as great or 4,900/f.

This is also true for 72-ohm coaxial cable, only the velocity factor is greater, approximately 66% or 0.66.

The table shows the approximate lengths of a shorted half-wave stub for channels 2–13. The lengths are not critical since the velocity factor of a 300-ohm line may vary from 80% to 86%. In addition, this factor is influenced by the physical location of the stub. The proper procedure is to cut the stub a few inches longer than the theoretical value (based on the center frequency of a channel). Then, with the interference on the screen, use a razor blade and short the stub at the end observing the screen. Next, move the shorting point in ⅛- or ¼-inch intervals toward the receiver until you pass through a minimum interference point. Here, the line should be cut and permanently shorted. In the process be careful to cut only the insulation, not the conductors.

After finding the optimum length on a half-wave stub, cut the line about ½ inch longer, strip the insulation, short the leads and solder them.

In some cases attenuation by the stub is excessive, deteriorating the desired signal as well as eliminating the interference. If this occurs, instead of shorting the trap, terminate the end with a small carbon resistor, lowering the Q of the stub.

For fairly strong interference a resistor of about 20 ohms can be used; for a weak interfering signal use about 150 ohms. The larger the resistor the

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lower the rejection and the broader the response. Shorted leads produce an attenuation of about 8 to 1, a resistor of 40 ohms will attenuate a signal approximately 3 to 1. When trimming the stub, have it, as much as possible, in its permanent position. Moving it after final adjustment can alter its attenuation properties.

When other channels are to be received, including the one producing the interference, it may be necessary to remove the trap from the antenna input circuit, easily done with a dpdt switch. This situation sometimes occurs when a desired signal is a harmonic of the stub frequency and is attenuated. When a section of coaxial cable is used as the stub, trimming can be done with a needle or thumbtack. Simply puncture the coax, shorting the inner conductor and the outer shield. Continue to do this, moving toward the receiver terminals. If an open-ended quarter-wave section is used, more care must be taken since trimming is done by clipping off small sections of line that cannot be replaced. However, a little experience at this will let you know just about the point of maximum interference rejection.

| Channel | Inches |
|---|---|
| 2 | 84 |
| 3 | 77¾ |
| 4 | 71 |
| 5 | 62 |
| 6 | 57⅝ |
| 7 | 27⅝ |
| 8 | 26¾ |
| 9 | 26 |
| 10 | 25¼ |
| 11 | 24⅝ |
| 12 | 23⅝ |
| 13 | 23 |

### Lack of brightness

*A Crosley chassis 473 came in with a peculiar set of symptoms. The first thing I noticed was a considerable lack of brightness. The horizontal output, damper and high-voltage circuits checked out perfectly. I then noticed that varying the contrast control produced the effect of varying the brightness control. The video amplifier tube was replaced and all components checked but nothing was found to be defective.*

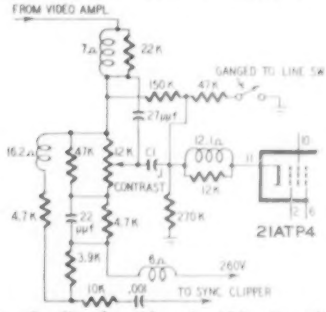



**Fig. 2—Crosley chassis 473. Coupling circuit from video amplifier to kinescope.**

*The signal applied to the cathode of the 21ATP4 picture tube is about 60 volts peak-to-peak, which is just about normal. Figuring that the picture tube might be defective, I replaced it, but*

*still no change in the symptoms. The video amplifier circuit in this set is fairly complicated, and it is difficult to get voltage measurements and tell from them just what the trouble is. Have you any information on this defect?—T. R., Spokane, Wash.*

The most important symptom you noted was the fact that the contrast control had a significant effect on the brightness. The logical component to cause this effect would be a defective coupling capacitor, C1 (Fig. 2). With this unit open or leaky, a high positive voltage is placed on the cathode of the picture tube, and variations in the contrast control produce variations in the picture-tube bias.

A quick check of this trouble consists of turning to an inactive channel and turning the brightness control to maximum. Then vary the contrast control to minimum. If the brightness of the raster changes, it is almost certain that this capacitor is at fault.

### Printed-wiring connection

*I have recently been getting some sets that use printed-circuit wiring and have had some trouble repairing breaks and raised foil. It appears to be a*

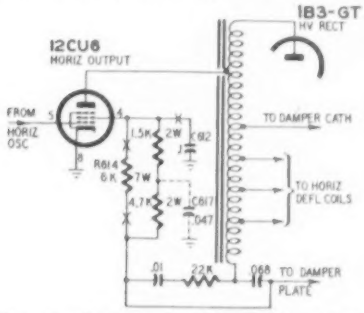


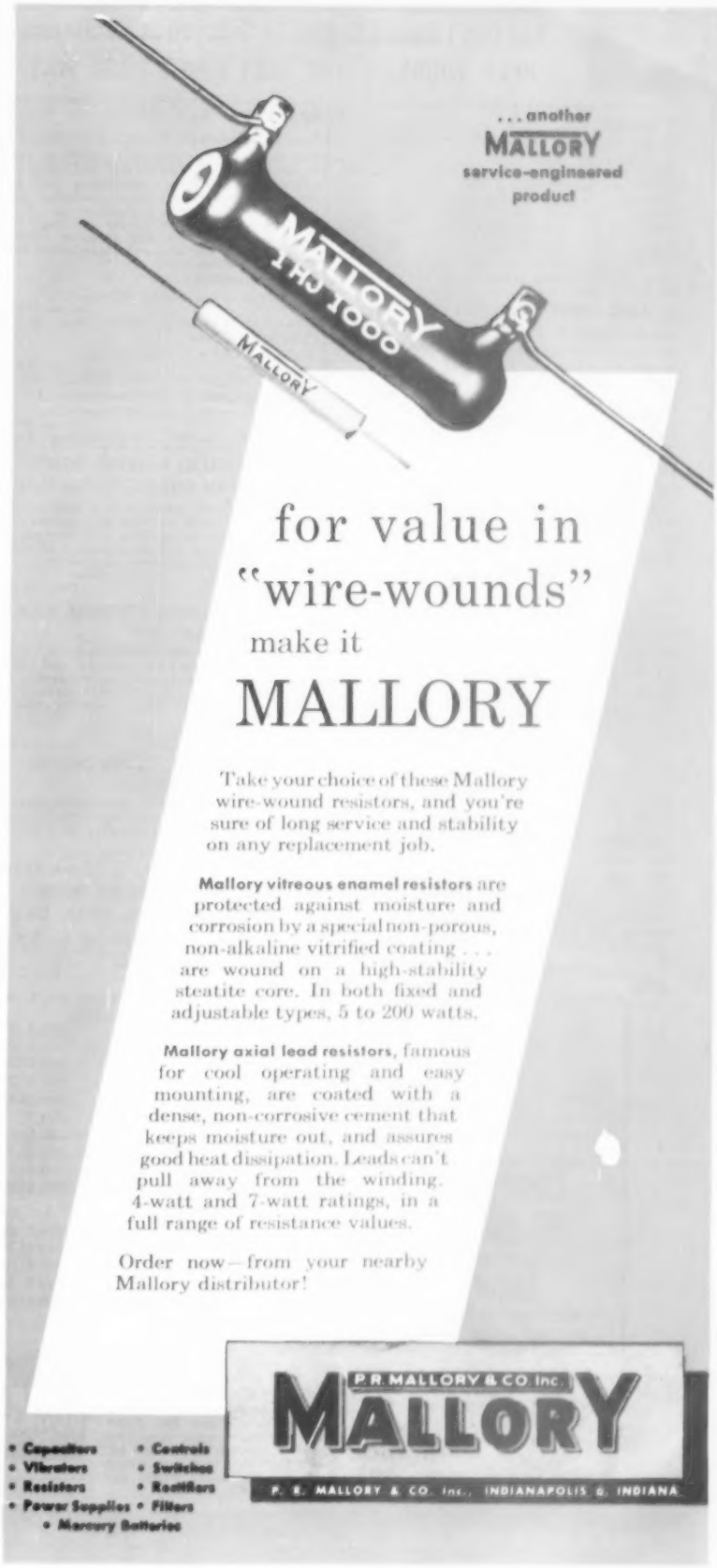

**Fig. 3—Capehart CX43 with circuit modified to eliminate snivets.**

*simple job but I have had callbacks with sets in which I repaired breaks in the printed wiring. Perhaps there is some special procedure that can be used for this type of work. I would appreciate any suggestions you may have.—T. S. E., Scranton, Pa.*

Repairing printed wiring is not a special art, but simply requires careful soldering. The usual precaution of applying no more heat than is necessary should be followed, and all materials in the soldering operation should be *clean*.

If one of the connecting copper strips or foil on the printed circuit board is cracked or broken, two methods can be used for repair. If the break is very small (a crack), tin both sides of the break and flow solder across the gap. If the break is large, tin both sides of the break and lay a piece of hookup wire across the gap, allowing about 1/16-inch overlap. Then solder the wire to each side of the gap.

Bare wire can be used if the break is small, and insulated wire if there is a chance of a short circuit. The wire should be tinned before use. If the

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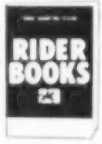


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printed-circuit foil becomes raised from the board or panel, simply cut off the raised portion and replace it with a piece of wire as done with a break. Once again, watch out for excessive heat from the soldering iron.

### Snivets

*What appears to be a drive line is on the right side of the screen in a Capehart CX-43 chassis. The set has no drive control, but I inserted a trimmer in the output tube grid circuit and varied it. There was no change in the vertical line. I replaced the 12CU6 with a few other new tubes, but the effect remained and only varied slightly in intensity. I also noticed that the line was stronger on the higher channels and on weaker stations. On inactive channels the line broadened into several wavy vertical lines.*

*Changing component values in the horizontal output circuit helped somewhat but fell far short of clearing up the trouble. I tried placing an ion-trap magnet over the output tube as in Barkhausen oscillations, but this had little effect.—M. R., San Francisco.*

It appears you have on your hands a little case of snivets. This is somewhat similar to Barkhausen oscillations but appears on the right side of the screen. There is radiation from the horizontal output stage which is picked up at the lead-in to the tuner. The effect is most noticeable on the weaker channels because the age voltage is low and the gain of the set is high. In some cases an ion-trap magnet placed over the horizontal output tube will clear up the trouble only to the extent that the oscillation frequency will be off the television bands.

In your chassis, the snivets can be removed by introducing some degeneration in the screen-grid circuit (Fig. 3). Remove the present 6,000-ohm screen dropping resistor and replace it with 1,500-ohm and 4,700-ohm resistors—2 watts should be sufficient. Then, remove C612, leaving the 1,500-ohm resistor unbypassed. A smaller .047-μf capacitor is then connected between the two screen resistors. Whether this resistance breakdown will provide optimum attenuation of the snivets cannot be certain, and you may have to experiment with various combinations that total approximately 6,000 ohms. END


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# tv dx

By
ROBERT B. COOPER, JR.

TELEVISION dx, being seasonal, has always attracted a number of fair weather dx'ers and a smattering of enthusiasts who stick with the dials all year long. This is not the way we can truly explore the potentials of long-distance television reception. Our mail indicates another breed of dx'ers—dial twisters who find as much pleasure in noting what is *not* coming in as well as what is making the grade.

Typical of the "all-weather dx'ers," Mrs. Doris Johnson of Longview, Wash., found time to log some very impressive dx during the normal "dead-band" conditions of January and early February. Included in her log are 22 meteor-scatter skip loggings, with 7 new stations!

## Sporadic E

Although we mentioned the sporadic-E opening of Jan. 3 in our March TV dx column, numerous reports have since arrived, many of which are worthy of mention. This opening was one of the biggest ever observed in winter and even rivals some of the day-long summer openings of past years. Frank Hill of Gallipolis, Ohio, describes the opening as the "best he had ever seen," bar none. And this is from a dx'er with over 200 stations to his credit! From all appearances, the skip began shortly after noon EST and was still going strong by 8 pm EST. The only area of the country that appears to have escaped the barrage of TV dx signals is the greater Northwest. If this type of opening is any indication of the summer sporadic-E season, we will have quite a summer on our hands!

## F2 skip

To this date, no reports of F2 reception from South American or Hawaiian stations have reached this desk, although we feel sure that there have been instances when the skip reached channel 2 between the two continents during February. From San Antonio, Tex., Calvin R. Graf reports continued reception of sound transmissions of European television stations as late as Feb. 1. Along with the stations mentioned in the last column, dx'er Graf has added calls from Russia (5,800 miles!) and Ireland.

Down in Australia, television has just begun to find a foothold, with two-three stations actually operating in Sydney and Melbourne at present. To George F. Palmer, of Victoria, Aus-


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tralia, television reception problems are not at all new, however. Mr. Palmer has been set up for television reception for several years now. Complete receiving setups for both American and British transmissions, including the appropriate antennas, all mounted on a 90-foot tower, have been functioning almost continuously for over a year. In this time, no dx reception has resulted, but Mr. Palmer is not ready to give up. In fact, he has high hopes for reception from the Hawaiian islands at some time during these spring months. Reception of the BBC channel-1 broadcasts from London, on 41.5 mc, should also be possible soon.

Not in the category of F2-layer reflection, but in the limits of international dx, we have a report from Egon Strauss, Buenos Aires, Argentina. Included with this report are several photographs taken of Station PRF-3-TV, channel 3, Sao Paulo, Brazil, as received on Dec. 31, 1956. It is interesting to note that this date also produced sporadic-E skip in the northern areas of the United States, and at roughly the same time. RADIO-ELECTRONICS' TV Dx Column would be very interested in receiving any other TV dx reports from South America.

### Predictions for May

Scattered sporadic-E openings will be occurring as this is read, concentrating for the most part on late afternoon and early evening hours. Following a slow start, the major season should find a good foothold after the 15th of the month, with several large-scale openings before the end of the month. Watch the early-morning and early-evening hours for most of the sporadic-E reception. The period around the 25th may produce some excellent trops along the Great Lakes and throughout the midwest. Watch the high bands very carefully preceding a sudden increase in temperature and humidity in your area.

### June predictions

In the summer of 1956, sporadic-E skip peaked for the summer months in the first 10 days of June. In 1955, the month of July was definitely tops, as it was in 1954. We can only make an educated guess at what this year will bring. The first 12 days of June *should* see very frequent sporadic-E action, with some double-hop reception, especially along about the 5th. A slump wil probably occur around the 14th, if sporadic E follows its usual patterns, with reduced skip activity until the 24th or so. Trops reception in the fringe to 400-mile range will be very much above average during the entire month. The early morning and late evening hours will be best for extended trops reception.

### Report Forms

RADIO-ELECTRONICS makes TV dx report forms available free of charge. Simply address a postcard to TV Dx Editor, 154 West 14th Street, New York 11, N. Y. END


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# Patents

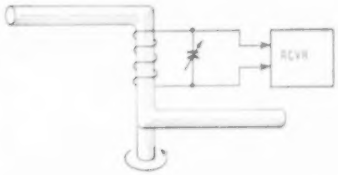
## ROTATABLE LOOPSTICK

### Patent No. 2,755,468

*Garrard Mountjoy, Canandaigua, N. Y. (Assigned to General Dynamics Corp.)*

Ferrite-rod antennas have been known for many years. They are straight rods which hold the antenna coil for the receiver. Such a unit is not easily rotated for optimum pickup without special mountings and slip rings or leaving enough slack in the connecting leads to permit 360° rotation without tangling or binding.

A new loop substitute shown in the diagram,




consists of two horizontal ends and a vertical portion that holds the coil. There is clearance between coil and core so the latter may rotate. The coil does not move. This loopstick may be built into a handle, in which case only the handle has to be rotated, not the set.

## LONG-LIFE BATTERY

### Patent No. 2,758,225

*Richard R. Annis, Colebrook, N. H., and Howard Haselkorn, Asbury Park, N. J. (May be used by U. S. Government without royalty payment)*

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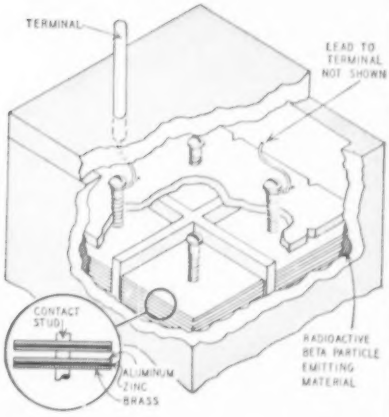


One element of each cell may be a metal with a high energy level like copper (or brass). The other is a metal with low level like aluminum. In a practical cell the plates are brass and aluminum with a layer of zinc between since brass cannot be easily plated directly to aluminum. The gas may be xenon and its ionizing source may be strontium 90 which emits beta particles.

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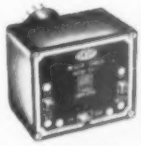

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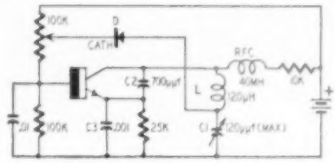
gram shows how four stacks may be connected in series for still higher voltage.

## REGULATED OSCILLATOR

**Patent No. 2,760,070**

***Edward Keonjian, Syracuse, N.Y. (Assigned to General Electric Co.)***

Transistors make useful low-power oscillators but their operation may be affected by temperature and voltage changes. In addition, their efficiency varies greatly with frequency. This new invention includes a regulating circuit.




The diagram shows a series-tuned Colpitts arrangement. The tank L is tuned by a variable capacitor C1. The necessary Colpitts tap is obtained from C2–C3. Part of the output power is fed through D to a potentiometer normally adjusted to block the diode. D can conduct *only* when the output signal exceeds a predetermined level. This drives the transistor base more positive and cuts conductivity, overcoming the tendency toward higher output.

The circuit shown here is designed for operation over a range of 1 to 2 mc. Its amplitude varies only 9%, although a variation of 41% was noted without the feedback.

## WAVE SHAPING

**Patent No. 2,769,137**

***Melville C. Creasere, China Lake, Calif. (Assigned to United States of America as represented by Secretary of Navy)***

Any desired response curve of current output vs voltage input can be matched by this network. It uses a single bias source acting on various shaping branches. Different curves can be matched by varying the resistance values and the bias voltage. Fig. 1 is designed to duplicate the curve equation:

$$I_{out} = 2.2374 \log e\ 0.747\ E_{in}$$

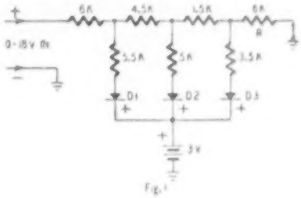



Fig. 1

Note how closely (Fig. 2) the measured output duplicates the computed curve.

When the input is low, all diodes are blocked by the positive potential from the battery at their cathodes. The output current (through R) depends only upon R and the three resistors in series with it and the input terminal. As the input voltage is raised, a point is reached where

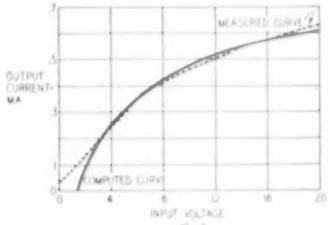



Fig. 2

D1 begins to conduct and add its current through R. This is a break point in the curve, which now has a lower slope. The next break point and changed slope occur when D2 begins to conduct, and so on. By proper circuit design, it is possible to control the actual break points and the changed slopes. Any desired curve can be matched if a large enough number of shaping branches is used. END

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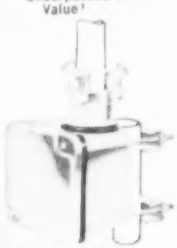

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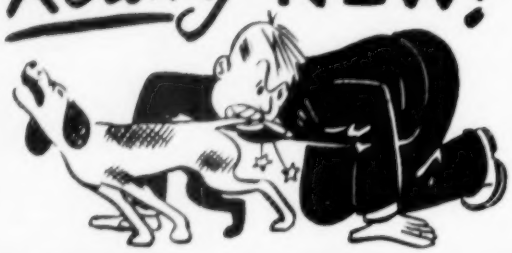

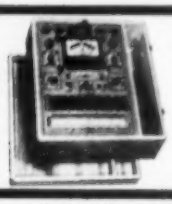

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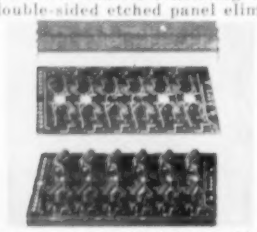

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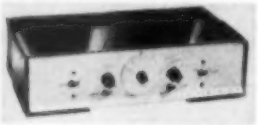

peaks) at all frequencies within audible spectrum. Variable-crossover feedback tone controls giving maximum boost and attenuation of 20 db at 20 and 20,000 cycles. 20-db feedback in power amplifier. Completely shielded and separately housed preamp—**Madison Fielding Corp.,** 863 Madison St., Brooklyn 21, N. Y.

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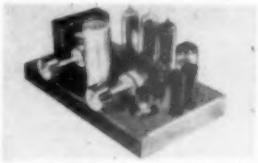

tor, volume control and switch and tone control. Complete instructions.—**Erie Resistor Corp.,** 639 W. 12th St., Erie, Pa.

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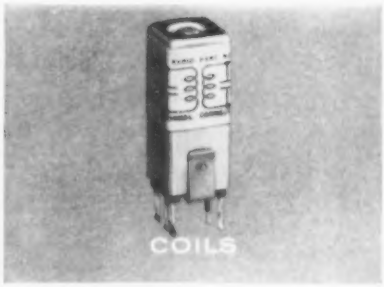

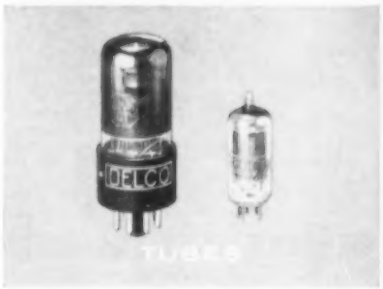


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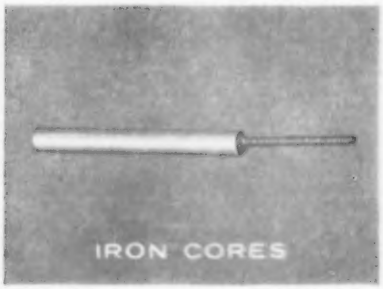


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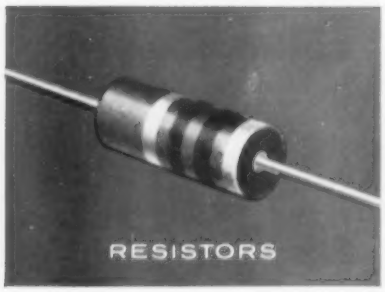


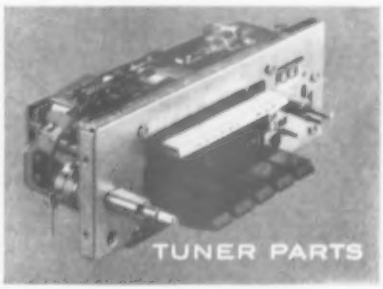


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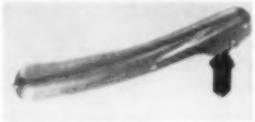

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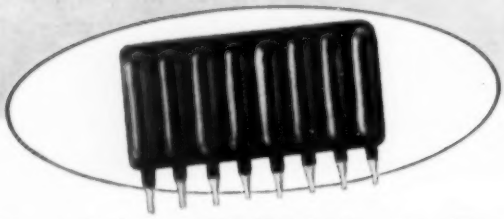

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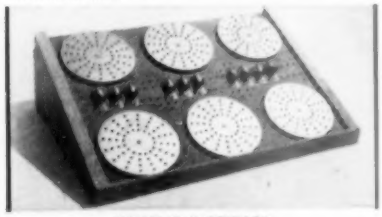

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itors including 2 large electrolytics. All components can be replaced singly if damaged by excess voltage or current. **Service Instruments Corp.,** 171 Official Rd., Addison, Ill.

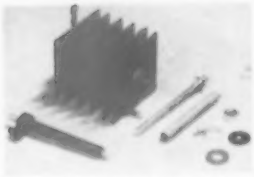
**CAPACITORS.** *Type NL, Electomite,* (illustrated), for transistorized, printed circuits and other compact low-voltage dc equipment. Working voltages of

1, 3, 6, 10, 15, 25 and 50, with capacitances from 1 to 200 μf. Sizes from 3/16 x ½ to ⅜ x 1 inch and can be operated within −20° to +85°C.

*NFT, Quietune,* for rf noise suppression in chassis, bulkhead, firewall, shield or other grounded metal partitions, are 3-terminal designs. 5, 15 and 25 amps. 100 to 600 volts dc, 125 to 250 volts ac, 0 to 400 cycles. Depending on voltage, capacitance from .001 to 2.0 μf. Temperature range −55° to 85°C and −55° to 125°C. Wire leads or solder lugs.

*SBXM,* for operation over −55° to +150°C, provided with high temperature glass-to-metal seals and solder lug terminals. Base size 1⅛ x 1 inch with heights of ½ and 11/16 inch. Ratings 0.1 to 2.0 μf at 200, 400 and 600 volts dc. Power factor does not exceed 1.5% at 25°C.—**Cornell-Dubilier Electric Corp.,** S. Plainfield, N. J.

**SELENIUM RECTIFIERS.** Assembly on prefabricated insulated stud. Planned to give rectifiers better mechanical stability and moisture resist-



ance, and improve uniformity by fewer assembly operations. **Federal Telephone & Radio Co.,** Clifton, N. J.

**MOUNTING BLOCK FOR SILICON RECTIFIERS.** Single- or double-pole type. Stop on one clip engages slot on positive pole of rectifier. Rectifier's negative pole is not slotted and cannot be inserted in clip with the

stop. Other clip, not having a stop, takes negative pole of rectifier. — **Bussman Manufacturing Co., Div. of McGraw-Edison Co.,** University at Jefferson, St. Louis 7, Mo.

**AMATEUR RECEIVER,** *model 4350.* Covers only ham bands. Crystal-controlled dual conversion. Triple spacing between tuning capacitor plates. 6-pound die-cast front panel. Welded chassis and case. Provides for phones or speaker. Noise limiter. 2-speed tuning knob requires no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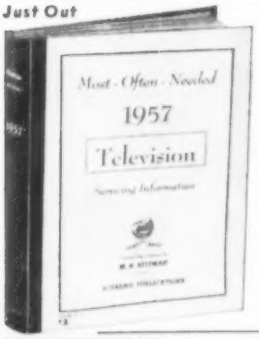


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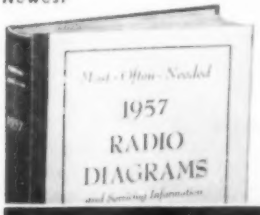


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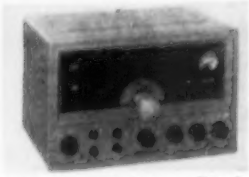

gears or strings. Receiver microscans a particular area by 75:1 reduction mechanism. 10 x 12½ x 10 inches. 36 pounds.—**Radio Manufacturing Engineers, Div. of Electro-Voice, Inc.**, Buchanan, Mich.

**RECEIVER,** *NC-66.* Can be used as 3-way portable, SWL, ham or marine receiver indoors and out. 115-volt ac/dc or battery operation; 5-band coverage from 150 kc to 23 mc; electrical bandspread with logging scale; fixed-tuned CW oscillator. Full-Vue

slide-rule dial, 5-inch PM speaker. Phone jack. Ferrite loop for direction-finding and broadcast bands, whip for SW bands and special marine band from 150 to 400 kc covering DF frequencies. 12 5/16 x 9 11/16 x 10 inches. 16 pounds. — **National Co.**, Sherman St., Malden, Mass.

**RECEIVER,** *SX-101.* Operates on 13 tubes, voltage regulator and rectifier. Covers 160, 80, 40, 20, 15 and 11–10-meter amateur bands. Special positioning of bandswitch permits reception of WWV 10-mc standard frequency transmissions. Built-in 100-kc quartz crystal calibrator. Avc system for single-sideband as well as CW. T-notch filter. Full gear-drive tuning. Selectivity from 500 to 5,000 cycles. Sensi-

tivity under 1.0 microvolt.—**Hallicrafters Co.**, 4401 W. 5th Ave., Chicago 24, Ill.

**VHF RECEIVER,** *Air-O-Ear.* Dc power kit (extra) permits home, car or plane use without special installation. Plugs into 115-volt ac wall socket or 6-volt dc jack. 6-tube superhet circuit with noise squelch control, selenium rectifier, automatic volume control, coaxial tuning, drift compensation, heavy-duty

6-inch oval speaker, dial calibrations from 108 to 130 mc. Portable. 7½ x 5 x 4½ inches. 5 pounds. — **Nova-Tech, Inc.**, 1721 Sepulveda Blvd., Manhattan Beach, Calif.

**DC POWER SUPPLY,** *model NFAE.* Steel panel for perma-

nent or semi-permanent rack mounting, fits standard RETMA and Western Electric racks. Can be used as portable all-around bench supply off rack.—**Electro Products Laboratories,** 4500 Ravenswood Ave., Chicago 40, Ill.

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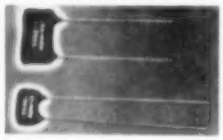

leads for automatic insertion on plug-in assemblies. Good for printed-wiring applications. Available in standard capacitance values at operating temperatures of −55°C to +125°C. —**Aerovox Corp.** 740 Belleville Ave., New Bedford, Mass.

**FLARED FERRITE CORE.** For use with new 110° picture tubes. Weight reduction of 30%

over conventional cylindrical cores made possible by shaping outer surface so that cross-section is approximately uniform from top to bottom.—**Allen-Bradley Co.**, 136 W. Greenfield Ave., Milwaukee 4, Wis.

**TV FLYBACK.** An exact replacement for Bendix parts Nos. NH265051-1, -2 and TSOH05 used in 26 chassis and

models. On mounting board with socket and associated components. — **Rogers Electronic Corp.**, 49 Bleecker St., New York 12, N. Y.

**All specifications given on these pages are from manufacturers' data.**

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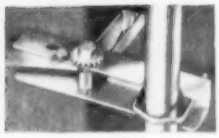

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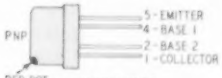
# New Tubes & Semiconductors

This month we have a large number of semiconductor devices, many of them produced by Texas Instruments Inc. There is also a 450-ma 110° picture tube and a group of silicon diodes with high amperage ratings.

### Tetrode transistor

The 3N25/501 grown-diffused p-n-p germanium tetrode is designed for vhf operation. The unit is hermetically sealed.




3N25/501

Its maximum ratings are: collector voltage referred to base, −15; collector current, −2 ma; operating temperature, 75°C.

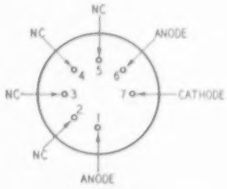
### 2N145, 6, 7

Designed to provide high gain in 455-kc common-emitter if amplifier applications, these are n-p-n junction type transistors.

Absolute maximum ratings are: collector voltage referred to emitter, 20; collector current, 5 ma; collector dissipation at 25°C, 65 mw. All units are thoroughly tested for design characteristics and 455-kc power gain.

### T1/680

A new full-wave silicon rectifier. Mounted in a cylindrical metal case with a glass-to-metal hermetic seal it fits a standard seven-pin miniature socket. In many applications it can be used in place of the JAN 6X4 rectifier tube.




T1/680

The T1/680 has the following characteristics: At −55°C to +100°C, peak recurrent inverse voltage (per section), 1250; average rectified forward current (per section), 37.5 ma; average output current (full-wave operation), 75 ma; ac anode voltage (per section), 400.

### 925, 926 tetrode transistors

Last of the Texas Instruments group are these two grown-diffused n-p-n silicon tetrode transistors.

The 925 is designed for 12.5-mc and the 926 for 30-mc operation. Maximum ratings for both are the same. At 25°C ambient they are: collector voltage, 30; collector current, 10 ma; base No. 1 current, 5 ma; base No. 2 current, 5 ma.

925

### 17CDP4, 110°, 450 ma

This is a new addition to the RCA 110° picture-tube group. It is designed with a 450-ma 8.4-volt heater having a controlled warmup time for use in television receivers using a single, series-connected heater string.

The glass picture tube has a 16 9/16-inch diagonal, is 12 9/16 inches long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and weighs 10 pounds. It is 3 inches shorter and 5 pounds lighter than 90° tubes of equal screen size.

Another feature of the 17CDP4 is its straight gun design, eliminating the need for an ion trap. It has a Filterglass faceplate, an aluminized screen, a minimum projected screen area of 155 square inches and an integral glass button base which eliminates the possibility of loose base-pin connections.

### CK768

Raytheon Manufacturing Co. has announced a new transistor with characteristics that make it especially suitable for broadcast receivers, if amplifiers and converter uses.

The CK768 is a hermetically sealed p-n-p fusion alloy-junction transistor primarily intended for amateur experimenters and hobbyists.

The collector-to-base maximum voltage is 30; collector to emitter voltage, 15, and maximum collector current, 100 ma.

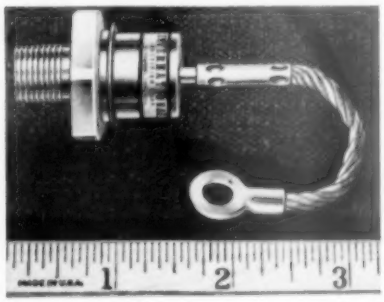
### 2N301, 2N301A

These new, hermetically sealed alloy-junction p-n-p power transistors, manufactured by RCA, are designed specifically for use in class-A and class-B push-pull, audio-frequency power output stages.

The 2N301 and 2N301A in class-A amplifiers at an ambient temperature of 55°C and with a zero-signal collector dissipation of 5.4 watts can deliver a maximum-signal power output of 2.7 watts with a 32.5-db power gain. In push-pull class-B service under the same operating temperature with a collector dissipation of 3 watts, two 2N301's or two 2N301A's can deliver a maximum-signal power output of 12 watts with a power gain of 30 db.

### Silicon diodes

A series of silicon power diodes has been announced by the International Rectifier Corporation. The new series




is rated to deliver 14–70 amps (half wave rating) and is available in voltage ratings of 50 peak-inverse-volts to 300 peak-inverse-volts. These diodes are designed for medium power equipment where high performance, high ambient temperature, reliability, high efficiency and miniaturization are prime factors.

They are hermetically sealed and the mechanical construction is designed for stability and reliability. END

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# Technicians' News

## NEDA, UESC MEET

Under the auspices of the National Electronic Distributors Association and with the cooperation of the United Electronic Service Council, a meeting to discover and discuss points of common interest for mutual action was held in New York City March 17. (UESC is a cooperative group formed to coordinate the efforts of the service organizations of the northeastern United States.)

Nearly 100 persons attended. About two-thirds of them represented the service industry and the other third participating NEDA representatives and observers from the Radio-Electronic-Television Manufacturers Association (RETMA) and independent manufacturers. The service delegates represented the eastern edge of the country with a scattering from other states, including one from Texas and one from Arizona.

The meeting was opened by Frank Silverman of UESC, after which Joseph A. DeMambro, president of NEDA, addressed the group. He pleaded for unity for the mutual benefit of all sections of the electronic industry, and laid down the program for the meeting:

To improve communications between manufacturers, distributors and service groups; to determine areas of cooperation for mutual benefit; to assist in reducing industry misunderstandings, and to give recognition to the doctrine of industry interdependence.

A number of points were then discussed, including possibility of joint educational work to upgrade the technicians' reputation; the problem of the distributor's sales policies as they affect the established service dealer; advertising claims on products the service technician has to install and repair, captive service and licensing.

The most important suggestion made was that a representative of service be placed on the board of NEDA's educational committee. This was well received by NEDA members and, while necessarily subject to ratification by NEDA, seemed practically an accomplished fact by the end of the meeting. A joint educational campaign was also accorded general agreement. The question of distributor-service dealer relations was reported as under study with prospects of a report at the next meeting, date of which was to be determined later. There was no extensive discussion of captive service at the meeting proper, though after the formal adjournment John Thompson of General Electric


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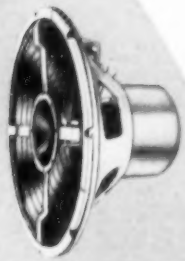

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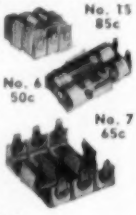


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components division outlined his company's policy and answered a number of questions on the subject.

### INCREASE OR NO CREDIT

Cheyenne (Wyo.) radio and TV servicing departments faced with either raising prices or eliminating credit decided to require cash for servicing jobs. The basic servicing fee of $5.75 will not be changed. For major repair jobs financing can be provided.

It was decided that all service departments would keep the same hours, 9 to 6 weekdays, 9 to 1 Saturday. After hours, time and a-half will be charged for service calls, with a service charge of $8.65.

### BALK TUBE FRAUD

RETMA's general counsel, Glenn McDaniel, said tube and set manufacturers are destroying all worn-out tubes returned to them under warranties to eliminate that source for tube counterfeiters. He further said that manufacturers had taken this step at RETMA's suggestion. After cautioning the public about methods used by tube forgers he stated it would be a good idea if consumers ask their repairman to leave all worn-out tubes when he finishes a repair job.

### PRSMA ELECTS OFFICERS

The Philadelphia Radio Servicemen's Association re-elected William L. Poole president. Fred Cohen was elected vice president; A. P. Greben, recording secretary; William P. Humes, treasurer and Leonard Shaw, corresponding secretary.

Elected to the board of directors were William Royal, Richard D. Devaney, John Brozenske, Samuel M. Brenner and William Abbott.

Messrs. Poole, Humes and Brenner were named as delegates to the Federation of Radio Servicemen's Associations of Pennsylvania.

### TROY STUDIES LICENSING

The city lawmaking body of Troy, N. Y., has set up a three-man committee to study the proposal that television repairmen be required to have a city license. The proposal called for a board of examiners to be set up to control licensing. This board would operate as existing licensing agencies do for electricians, plumbers and barbers.

### SERVICING WEAKEST LINK

The electronics industry's growth is limited or retarded by the weakness of the television servicing industry. This was stated by Morris Green, Philadelphia distributor and chairman of the Joint Educational Committee made up of members of the Radio-Electronics-Television Manufacturers Association and the National Electronic Distributors Association.

Mr. Green also pointed out that, of the three elements in the radio–TV parts system, servicing is the weakest link.

At a recent meeting of NEDA, Mr. Green said efforts of the educational committee throughout the country have "met with cooperative response. By and large, we were received by service leaders with intelligent and diplomatic attitudes who were trying to work for the service dealer and technician."

## GUILD BACKS LICENSING

The Radio & Television Guild of Long Island telegraphed Gov. Averill Harriman, State Senator Walter J. Mahoney and State Assemblymen Oswald Heck, Joseph Carlino, Francis McCloskey and Bernard Dubin, endorsing the bill to license television repairmen recently introduced in the New York State Legislature.

The telegram listed five points the guild considers essential to any TV repair licensing bill:

1. That service technicians meet certain minimum technical qualifications.
2. That the service technicians have financial responsibility through insurance or bonding.
3. That the service technicians have an established address so that the public may obtain recourse.
4. That the practicing service technician have representation in the preparation of the licensing measure.
5. That provision be made for the practicing service technician to be a part of any commission established to administer TV licensing.

The telegram went on to state, "The Radio & Television Guild strongly endorses, if the above conditions are met, any steps toward a state-wide license to protect both the public and the ethical TV repairman. . . . Strong exception is taken to the remarks of Assemblyman Bernard Dubin that there are many unscrupulous television repairmen."

## FACTORY SERVICE CRITICIZED

Television manufacturers have been strongly criticized by the Empire State Federation of Electronic Associations Inc., for the trend they have established of providing service policies with new receivers.

The federation said that this trend could force the independent service technician out of business.

A talk by Max Liebowitz, past president of ESFETA, suggested possible encroachments in the service field presented by module and printed-circuit construction. This type of construction could enable factory service to make quick repairs in the home with unskilled help.

## KCTSA ELECTION RETURNS

The King County Television Service Association of Seattle, Wash., elected new officers for the coming year: president, Harold Hart; vice-president, Clayton Faller; secretary-treasurer, Ray Murphy. END

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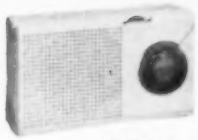

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OPERATING FREQUENCIES
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I.F. AMPLIFIER—455 KC
POWER OUTPUT—275± milliwatts
SPEAKER—large alnico V permanent magnet
TRANSISTOR COMPLEMENT
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X2 1st I.F. amplifier
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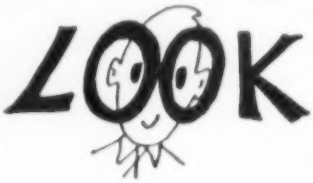

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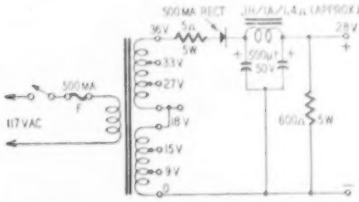
# Question Box

## 6–8-VOLT ELIMINATOR

*I have a surplus Packard-Bell model K-1 preamplifier designed for magnetic microphones. It operates from a 28-volt dc supply and draws approximately 400 ma. Please print the circuit of a suitable battery eliminator.—L. J. M., Portland, Me.*

The battery eliminator is shown in the diagram. The power transformer should deliver 36 volts at 500 ma or more. The rectifier may be a selenium, germanium or silicon type for ac inputs of 36 volts or more and a current rating of at least 500 ma. The transformer and choke may be Tabtran (TAB, 111 Liberty St., New York) types TR50007 and CR6001, respectively. The size of the filter capacitors may have to be increased to eliminate ripple in some applications.




Outputs of approximately 28, 24, 21, 14, 12 and 6 volts dc can be obtained by connecting the input side of the rectifier to the appropriate tap on the transformer secondaries. If the two tapped secondaries are paralleled, 6, 12 and 14 volts dc can be obtained at twice the current available with the series connection used in the diagram. Transformer, choke and rectifier with higher current ratings can be used when higher current is needed. Select a value for the bleeder resistor so it will draw about 10% of the rated load current.

The unit can be used as an emergency battery charger by removing the filter components and replacing the transformer and rectifier with units rated at 6 amps or more.

A voltmeter and ammeter will be useful when using the unit as a battery eliminator or charger.

## PHONOGRAPH FILTERS

*I would like to have circuits of a scratch and rumble filter or a rumble filter alone. Please print them in an early issue.—E. J. F., New York.*

The diagrams in Figs. 1 and 2 show rumble and scratch filters, respectively. Fig. 3 shows scratch and rumble filters selected alternately or simultaneously by a switch. The scratch filter consists

(Continued)

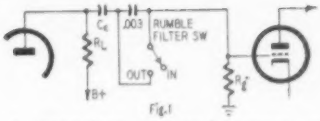



Fig. 1

of a capacitor shunted across grid resistor $R_g$ in one of the voltage amplifier stages. ($R_g$ may be the volume or loudness control in the amplifier.) Nominal values for the shunt capacitor vary from about .001 to .003 $\mu$f, depending on the value of $R_g$ and the scratch frequency. Try higher and lower values of shunt capacitance for optimum performance.

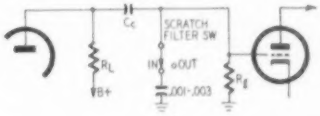



Fig. 2

The rumble filter in Fig. 1 consists of a small capacitor inserted in series with interstage coupling capacitor $C_c$. This capacitor provides greater attenuation at the low frequencies. Try values between .002 and .006 $\mu$f.

The rumble filter in Fig. 3 is a high-pass filter that cuts off or greatly attenuates the band of frequencies in which rumble normally occurs. Its effectiveness depends on the rumble frequency and the values of $R_l$ and $R_g$. Experiment for best performance. Try .01, .015 and .025 $\mu$f for C1; 330,000 ohms to 1 megohm for R1 and .006 to .02 $\mu$f for C2.

The rumble filter in Fig. 1 can be substituted for that in Fig. 3 but the

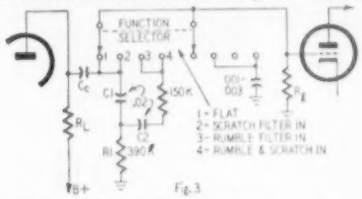



Fig. 3

rolloff will not be as sharp and you will get some unwanted attenuation at frequencies close to the rumble frequency.

## BCI FROM TV SETS

*I would appreciate any information that you can offer on reducing the interference that my TV set causes on nearby AM and shortwave receivers.—J.B., Williamsburg, Mass.*

Interference that TV sets cause on AM receivers is of two general types. One is the signal from the TV if circuits, normally received when the (shortwave) AM set is tuned to the TV intermediate frequency.

A more common and far more annoying type is caused by radiation of harmonics from the TV set's 15,750-cycle horizontal sweep circuit. This interference appears as hash between stations and as whistles when stations are tuned in. It is usually stronger on the low-frequency end of the band and gradu-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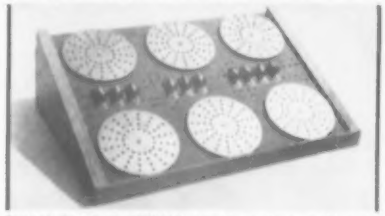

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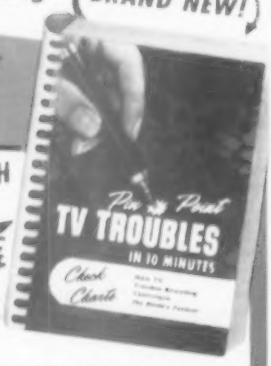


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On 17" and 21" specify type number of CRT used

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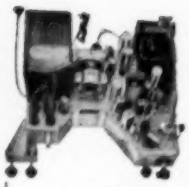

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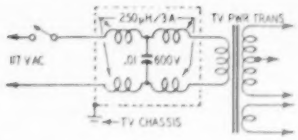
QUESTION BOX *(Continued)*




ally gets weaker as frequency increases. (Some sets may be most sensitive on the high-frequency end of the broadcast band and on the shortwave bands so the interference intensity may appear to *increase* with frequency.)

Remove the antenna from the TV set and note whether the interference disappears or decreases. If it does, a good high-pass TV filter connected to the TV set's antenna terminals will probably eliminate the trouble. Residual interference may be further reduced by using shielded 300-ohm transmission line between the input to the tuner and the antenna terminals on the back of the set. If the interference does not decrease when the high-pass filter is installed, it is being radiated directly through space or over the power lines.

The next step is to try shunting a .01-μf 600-volt capacitor across the power line on the set side of the interlock connector. If the shunt capacitor does not help, a pi type filter may. The construction is shown in the diagram. You can use four individual 250-μh rf chokes or a pair of dual units like the J. W. Miller D-7825-3. Mount the filter components in a shield under the chassis and grounded to it. This home-made filter or the Miller 7815 TV line filter will greatly attenuate interference radiated from the power line.

Frequently interference is radiated directly from the yoke, horizontal deflection leads to it or from the bell of the picture tube. In this case, the most effective remedy is to completely shield the inside of the TV cabinet with fine copper screen grounded to the chassis. Note well that the screen must be fully protected against accidental contact since it can cause a dangerous shock if the set has a hot chassis. Fine-screen mesh will reduce the circulation of air through the cabinet and around the tubes and other components, so take care to provide adequate ventilation. Additional holes may be cut in the cabinet bottom and back cover to allow free passage of air. END

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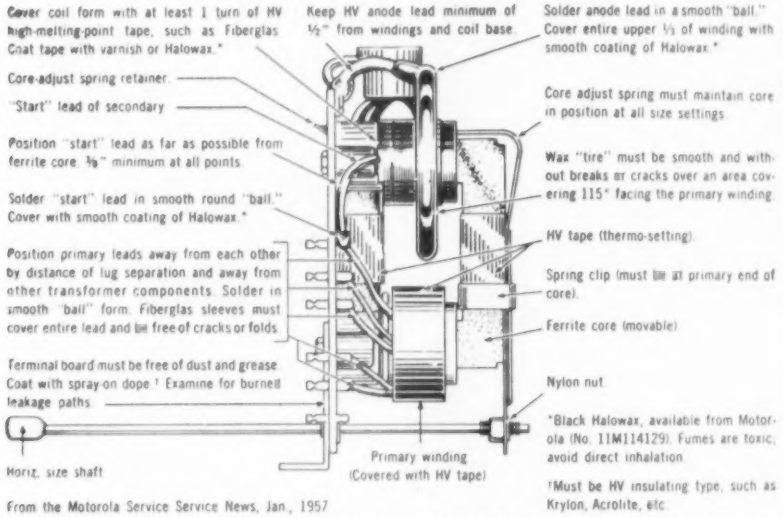
# Technotes

## HIGH-VOLTAGE TRANSFORMER REPLACEMENT

The modern TV receiver is often called upon to operate in locales which aggravate the breakdown characteristics of the high-voltage components. In such areas, the technician is plagued not only by original parts breakdown, but breakdown of replacement items.

Factors contributing to high-voltage breakdown problems are: extremes of humidity, temperature and dust content; high altitude locations and excessive line voltage; areas having non-sinusoidal waveform line voltage (in latter case, the waveform may have a high peak value but will show proper voltage on the voltmeter).



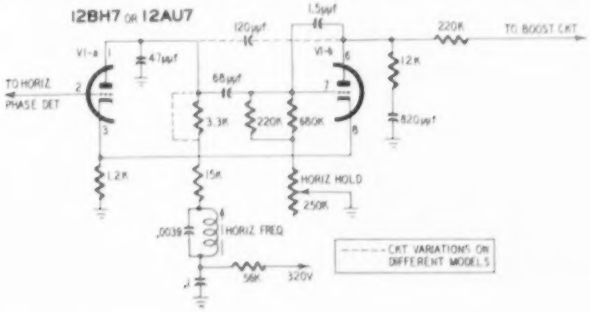

From the Motorola Service Service News, Jan., 1957

The information with the diagram outlines the techniques required, in high-voltage transformer or coil replacement, to combat breakdown problems most effectively. These hints will extend the life of flybacks.

## WESTINGHOUSE MODEL H-626T16

This receiver came to the shop with a burnt-out flyback and defective 6AU5. The units were replaced and still no high voltage. The set uses a ringing coil and a multivibrator type circuit. Replacing the 68-$\mu\mu f$ capacitor on pin 6 of the 12AU7 or 12BH7 horizontal oscillator, installing a new 680,000-ohm resistor in series with the horizontal hold control and a new 220,000-ohm resistor from the boost point to pin 6 of the horizontal multivibrator fixed that one.

The ringing coil in the V1-a plate circuit has little or no effect on the horizontal hold. If horizontal hold cannot be obtained in the center of the hold range, vary the value of the 680,000-ohm and 220,000-ohm resistors. The 68-$\mu\mu f$ capacitor is very critical and affects not only the hold but the width of the picture. I found that a ceramic





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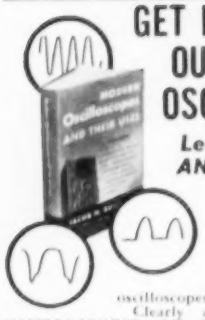

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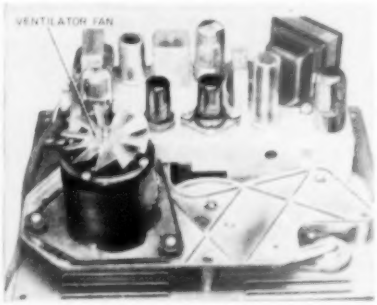
padding capacitor was far superior to the mica unit for control of width and hold. Use one that goes to 75 $\mu\mu$f.

In servicing these receivers, note whether the diagram you have and the set you are working on are the same. This particular receiver came through with many variations.—*Jacob Dubinsky*

## RECORDER FAN BLADES

The arrow in the photo points to the ventilating fan attached to the motor shaft of a tape-recorder drive motor. When removing the chassis of the recorder from its case for tube checking or other servicing such as belt renewal, be extremely careful with the fan. Even slight bending of the blades will unbalance the motor. It is very



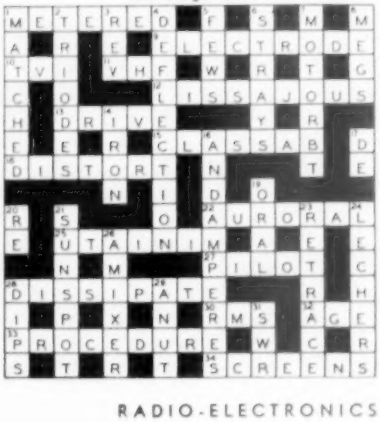

difficult, without special jigs, to restore the blades to their original position. The unbalance will make recordings and playback wobbly due to the assembly shaking and mechanical noise.

An empty cardboard carton or similar device such as a flour or coffee canister may be slipped over the motor and fan to prevent mishaps.—*A. R. Clawson*

## SYLVANIA 1-521, 1-533

Watch yourself when you have this chassis on the bench! The correct yoke *must* be used because the unused terminals on the yoke socket are used as tie lugs. A patch cable used to connect the yoke in the cabinet to the chassis on the bench may also give trouble in this respect. Using a patch cable may disturb noise inverter operation, causing pulling horizontally or loss of sync.—*Sylvania Service Digest* END

**Answer to Electronic Crossword Puzzle on Page 56.**



***Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.***

### *Chromatic Scale Test Record*
**Cook Series 60**

The first novely of this Cook record is: instead of using the now-conventional mathematical progression of test tones, the Series 60 provides a complete musical chromatic scale covering the entire range from C sub 3 (32.7 cycles) to the fifth C above middle C (8, 72 cycles). Every musical interval is thus covered and any gaps, peaks, dips, nulls, etc. will show up. The first chromatic sweep is followed by rapid sweeps which help to pinpoint any aberrations. Then comes a band of fast octave skips to judge balance. The skips are based on the diatonic scale and thus again cover the entire range very tightly.

The second novelty is that one side of the disc presents the above (and following) material with Fletcher-Munson compensation. It is intended to be played back at minimum volume with the loudness control disabled. Assuming a flat system, the reproduction should result in the same volume throughout the sweeps. The other side is recorded without Fletcher-Munson compensation. Played back with one's own loudness control adjusted it also should play back with equal volume. Thus the use of both sides and the contrast between them permits not only a test of "acoustic" flatness but an adjustment of tone and loudness controls to obtain acoustic flatness.

The most difficult of all audio qualities to test is transient response and Cook presents just about the most critical test on records in the two bands of tone bursts—short staccato bursts of high amplitude separated by very short intervals. The bass tone bursts on side A (with Fletcher-Munson compensation) present quite possibly the most severe test of pickup and tracing ability I have run across so far, and will wipe off the smiles of complacency of designers and manufacturers of even the finest cartridges and arms.

Assuming the pickups do deliver the goods, the bursts provide an equally severe test of speaker quality—few speaker systems will pass at all and probably none with flying colors. The treble tone bursts are not quite so severe, but useful for testing hangover and cone breakup.

The tone bursts are followed by a series of C's from middle C up and down, each C in several successive levels of double intensity. The lowest C on side A in its loudest tone presents one of the biggest swings ever put in the grooves and few pickups will track it even with the pressure increased. Finally, there is a band of standard A (American 440 cycle) to be used for tuning instruments as well as to test wow. The label has a stroboscopic pattern so turntable speed can be adjusted to provide exact pitch.

Side B is identical except that it is recorded without Fletcher-Munson compensation to the standard RIAA curve. It is therefore less demanding and yet provides extremely useful test material in comparison with side A.

### *Adventures in Cacophony*
**Audiophile AP-77**

This is a worthy encore to Audiophile's *Echoes of the Storm* which for these many years now has been the *piece de résistance* of hi-fi concerts of noises. One side is devoted largely to the cacophony of the barnyard and includes dogs barking, infants crying, roosters crowing, hens announcing the arrival of eggs, pigs grunting and squealing, cattle bellowing, kittens

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* Wiring diagrams are included with each unit. Proper diagnosis is not an immediate problem, because the 'Nu Life' Kinecure cannot harm either the picture tube or the receiver even if the jumpers are placed incorrectly.

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meowling and tomcats howling, plus frogs. The other side presents a sound picture of Milwaukee river traffic, clocks close up in assorted sizes and ticking rhythms, a narrow escape at a railroad crossing, a wonderful misused old typewriter and a water pump. The recording is notable not so much for its acoustic verisimilitude and realism as for the remarkable natural transients. The air blasts of chickens taking off in flights is especially remarkable on a fine system. The cacophony will not seem equally natural to all. The repertoire of the tomcats, for example is rather different from that of the hill-billy toms I know best, and the dog growling is like neither the Chesapeake Bay retriever nor the wirehair I know best. But there is no questioning the "you are there" presence. I can guarantee that the record will delight lovers of natural sound and the audiences of their impromtu concerts.

**VON SUPPE:** ***Overtures***
***Light Cavalry, Poet and Peasant, Galatea, Boccaccio, Morning, Noon and Night in Vienna, Fatinitza***
**Adrian Boult and Philharmonic Promenade Orchestra**
**Westminster XWN-18238**

A superb demonstration and showoff record with just about everything in its favor, including a fine well-defined bass, plenty of high highs, excellent balance and ever popular music presented with a really spectacular clear and clean sound. Cannot possibly fail to please.

**TCHAIKOVSKY:** ***1812 Overture***
**LISZT:** ***Mephisto Waltz***
**WEINBERGER:** ***Polka and Fugue from Schwanda***
**SMETANA:** ***Bartered Bride Overture***
**DVORAK:** ***Carnival Overture***
**Fritz Reiner and Chicago Symphony**
**RCA Victor LM-1999**

It would be difficult to find any handful of short works more suitable for hi-fi demonstration than these. All have spectacular moments and between them they cover the entire gamut of bravura musical, as well as hi-fi, effects. Reiner and the Chicago Symphony give them a very worthy performance indeed. The recording is excellent with a big bass and tremendous peaks and provides a convincing demonstration of the need for and worth of first-class playback equipment, with music of very wide appeal.

***Toccatas for Organ***
**Robert Owen, organist**
**Westminster XWN-18363**

These are examples of the romantic French organ music of the period 1870–1930, very ornate and producing in spots, about the peak concatenation of sound any single organ played by a single organist can produce. The pedal is not particularly noteworthy, but the exceptionally high amplitude of the high manuals poses a pretty severe test of pickup tracing and resonance as well as cone break up in the mid-range and tweeter speakers. The recording is very good indeed and, if you hear any significant distortion (except in the innermost grooves), it will be the fault of the reproducing chain. Few organ records deal as well with less demanding material.

**HAYDN: Symphony No. 100 (Military)**
**Symphony No. 101 (Clock)**
**Waldike conducting Vienna State Opera Orchestra**
**Vanguard URS-492**

The second movement of the *Military* offers some spectacular demonstration material and this recording of it is on about the same level as the Westminster W-Lab 7024 which has been the sensation of more than one audio show. Here it is played quite a bit faster. The drums are not as low in pitch but more heavily damped. Though they are not quite as overwhelming as in the Westminster, the heavier damping, rapid tempo and extremely fine transient response of the recording provide a better test of low-frequency transient response and speaker hangover, though a somewhat less spectacular test of very low bass-frequency response. The Lab recording with its wider groove spacing, and much smaller approach to the center of the disc is a trifle sharper, cleaner and better defined, though this one is exceptionally clean even on the innermost grooves. The rapid roll of the tympani following the trumpet of the charge, near the end, provides especially exceptional tests of transient response and speaker hangover. High highs are very good. The system which reproduces it adequately deserves extravagant admiration.

The *Clock Symphony* does have as obvious a demonstration value. However, it too, has plenty of drums in spots. Both works are pleasant to listen to, hence, this is a record which can endear itself to both the hi-fi ear and the ear which merely wants to enjoy music.

***Espana***
**Slatkin conducting. Hollywood Bowl Orchestra**
**Capitol P-8357**

This contains Ravel's *Bolero* and *Alborada del Gracioso*, Rimsky-Korsakov's *Capriccio Espagnol* and Albeniz' *Triana* from *Iberia*, as fine a selection of music for hi-fi demonstration as you will find on one record. The *Capriccio* offers plenty of drums, cymbals and high-high fireworks, separately and together. The *Bolero* with its presentation of solos by most of the instruments in the orchestra is fine for testing or demonstrating naturalness. The *Alborada*, with its variety of rhythms and delicate tonal effects, demands fine definition and offers some fine drums and high highs and excellent dynamic contrasts.

The *Triana* is the least spectacular but has its hi-fi points, too. Slatkin and the Hollywood Bowl Orchestra do a fine job which will gratify both musical and hi-fi listeners. There is a big drum; the high highs are sharp and bright; there is a nice bandshell liveness and the performance is bright and properly spirited. I don't see how it can fail to please both those who want the music most and those who want hi-fi spectacularity.

**MEYERBEER:** ***Les Patineurs (Ballet)***
**STRAUSS,** ***Johann, Jr.: Graduation Ball (Ballet)***
***Levine conducting Ballet Theatre Orchestra***
**Capitol P-8360**

This is music from two recent ballets based on tunes by long-dead composers. The family will like it for the very pleasant music, and the hi-fi head of the house for the extremely fine double basses in the opening of the *Patineurs* (Skaters) as nearly like their own big natural, concert-hall selves as you are likely to get on records. Given a good bass response in the speaker system, you'll need very little bass boost to vibrate the floor. On the best you'll get that rosiny guttiness and slight roughness which distinguish the genuine live instrument from most reproductions. There are some very good drums, nice triangles properly in place at the back of the orchestra with the other percussion instruments, and brilliant sound throughout.

***Hi-Fi Holiday for Organ***
**Music of David Rose**
**Richard Ellsasser, organist**
**MGM E-490**

An even dozen of Rose's tunes and pieces, including *Holiday for Strings*, *Dance of the Spanish Onion*, *Deserted City*, etc., played by Richard Ellsasser on a theatre organ. The arrangements are commendably restrained and though they show off the "orchestral" potential of the organ they don't try to prove that one man and four manuals plus a pedal can outshout a big symphony orchestra. The recording is excellent. The pedal is good, the higher manuals clean; there is just enough reverberation for liveness, and the temptation to put too much in the grooves has been well resisted. It won't prove much to anybody, but those who like the organ should like it.

**RICHARD STRAUSS:** ***Till Eulenspiegel Death and Transfiguration***
**Reiner and Vienna Philharmonic Orchestra**
**RCA Victor LM-2027**

Probably the two most popular of Strauss tone poems in performances and interpretations which ought to reflect the composer's intentions as closely as is possible. Both have

very spectacular peaks and present many examples of Strauss' characteristic brass choirs, which offer a fine test of tweeter coloration and distortion. The bass is big and good. Eulenspiegel is one of the most delightful pieces of program music in the library.

**RESPIGHI:** ***Feste Romane***
***Rossiniana***
**Adrian Boult and Philharmonic Promenade Orchestra**
**Westminster XWN-18240**

*Feste Romane* is the companion to *Pines and Fountains of Rome* and shares the remarkable tonal effects of the other two, though not as popular as either. This very fine recording clearly presents the remarkable orchestration. *Rossiniana* is quite different, an exercise in variations rather than in orchestral tone. It is based on some musical notes left by Rossini and will be considerably easier to take by those who find the Roman pieces too impressionistic.

**RAVEL:** ***Trio in A Minor***
**FAURE:** ***Trio in D Minor***
**Beaux Arts Trio**
**MGM E-3455**

These are considered landmarks in French chamber music of the first quarter of this century. The small group of piano, violin and cello, miked close up, provides a high degree of presence with a good system. The music, though most likely to appeal to those with some musical experience, is not at all difficult to listen to. The recording is excellent and useful to demonstrate presence.

**SCHUMAN:** ***Symphony No. 3 (Rhenish)***
***Symphony No. 4***
**Dean Dixon conducting Vienna State Opera Orchestra**
**Westminster XWN-18368**

This will be of special interest to critics, music teachers and students because it is conducted by a young American composer. From a hi-fi point of view it is notable for the fact that the thread is cut at a remarkably high average level and will present a severe test for pickups. If they have peaks or are overdriven or the needle is poor, the high strings will be distorted and raspingly strident.

**BACH:** ***Toccata and Fugue in D Minor***
***Toccata and Fugue in F Major***
***Passacaglia and Fugue in C Minor***
***Toccata, Adagio and Fugue in C Major***
**Carl Winrich on organ of Varfrukyrka in Skanninge, Sweden**
**Westminster XWN-18260**

Here are four of Bach's finest longer organ works of particular interest for hi fi because they include also possibly his best writing for the organ pedal. A beautiful recording both musically and sound-wise and probably as good an introduction to Bach as there is on records. The pedal organ is extremely well recorded and on systems capable of doing the pedal justice will be highly satisfying. The upper manuals are also remarkably clean and free of acoustic distortion. This is the fourth of a series which will cover the complete organ works of Bach. If you have no Bach organ records now, you should get this, and Bach fans who already have one or more of these works might well find the duplication worth while in view of the beautiful overall tone.

***Bouquet of Blues***
**Dinah Shore**
**Various Orchestras**
**RCA Victor LPM-1214**

Connoisseurs of the real old blues will be outraged by the liberties taken with this great old form in this recording. Especially outrageous is the conga-ized St. Louis Blues. And many will remain convinced that Dinah Shore did far better when she was with the Lower Basin Street Chamber Music Society. Those who like the old classics in "progressive" garb won't mind and the hi-fi man will like the record for the intimate presence of the voice. END

*Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records,* RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*


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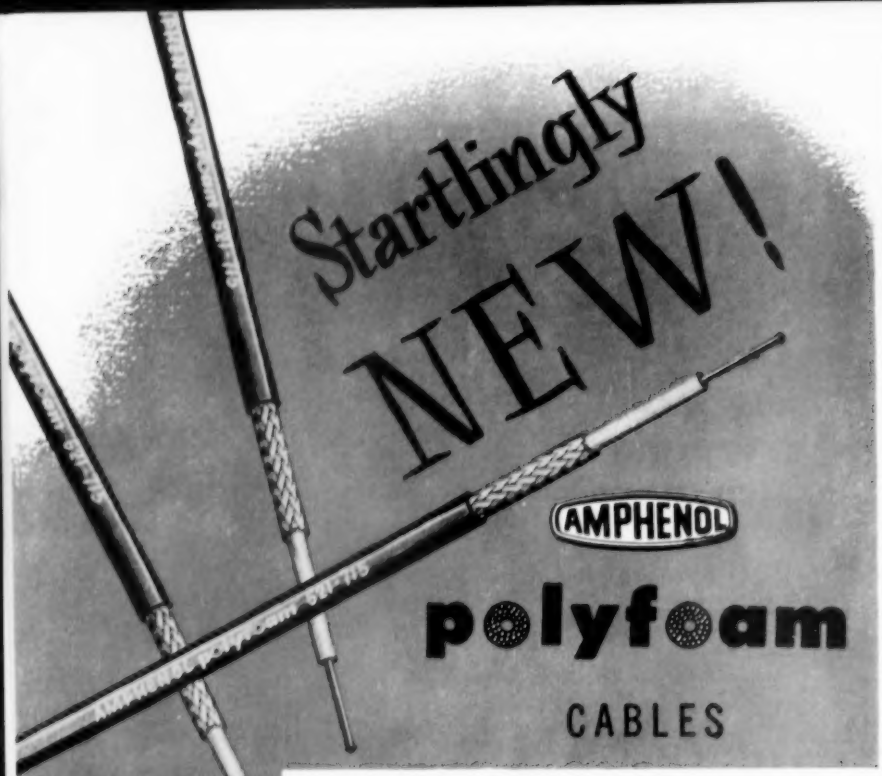


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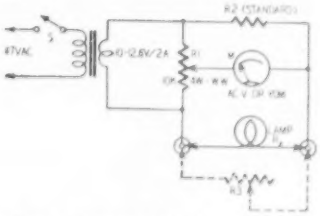
# radio-electronic Circuits

## THIS BRIDGE MEASURES HOT RESISTANCES

The simple bridge shown in the diagram is a convenient device for measuring the hot resistance of tube heaters and filaments and other resistive elements whose resistance changes with variations in operating temperature. The bridge has a range of around 1 to several thousand ohms. Accurate measurements are possible if you are careful when making the adjustments and recording the meter readings.

With the lamp or other resistance ($R_x$) in place, balance the brige by adjusting R1 for a minimum reading on the ac voltmeter. Always use the higher meter ranges until the minimum point is reached and then switch to a lower range for a more accurate adjustment.




After adjusting R1 for a minimum voltage reading, leave it as it is and record the voltage. Open line switch S and substitute variable resistor R3 for $R_x$. Close S and adjust R3 until the bridge is again balanced at the previously recorded voltage.

Leave R3 at this setting. Remove it from the bridge and carefully measure its resistance with an ohmmeter. The resistance of R3 equals the hot resistance of $R_x$. The initial value of R3 will depend on the lamp or resistance being checked. Usually a 100- or 1,000-ohm linear potentiometer will do.

The range of this bridge using any standard (R2) will be about 100 to 1. That is, if a standard of 10 ohms is used, the range will be from 1 to 100 ohms and lamps with resistances in this range may be measured. When using lamps of lower current, a standard of 100 ohms will give a range up to 1,000 ohms and down to 10.

Remember that the lower the resistance of standard R2, the more accurate the measurements will be. This is because there is less voltage drop across the standard and therefore less heat dissipation. The wattage rating of R2 must be such that it will not be overloaded for various lamps, and the

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voltage across this resistor should be about one-tenth of that across the lamp under measurement.

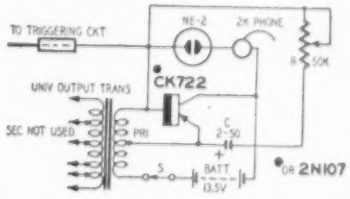
When building the circuit on a metal chassis, take care to prevent shock or damage due to short circuits. The 10,000-ohm potentiometer R1 should be mounted on an insulated panel. The power supply should always be a transformer to provide isolation. When measuring higher voltage lamps and tubes a 1-to-1 ratio isolation transformer is used. A 10-or-12 volt transformer is used when measuring small lamp resistances and when rebalancing the bridge.

Often we want to know the resistance of lamps operating at full voltage. Do this by measuring the voltage *across* the lamp while in the bridge. Under this circumstance the voltage across the bridge must be increased to overcome the voltage drop in the standard. Measurements may be made for any brilliancy of the lamp by varying the input to the bridge. Several readings at different voltages may be taken and a curve obtained for future reference.—*Alvin G. Sydnor.*

## PULSE AMPLIFIER

This unusual device, designed as a pulse amplifier for a Geiger counter, is suited to many applications.

It consists of a blocking oscillator stabilized by capacitor C and potentiometer R (see diagram.) A signal com-




ing along the single wire to the base triggers the circuit and a dc pulse of about 90 volts at 50 microamperes appears between base and collector. The output impedance is very high and a neon light is used as an indicator. Any other device using this pulse such as a phone or speaker must be in series with the neon light. If a meter is used, it should be placed between the positive pole of the battery and the transformer winding. About 20 microamperes flow through the meter but, when the circuit is triggered, the current rises to about

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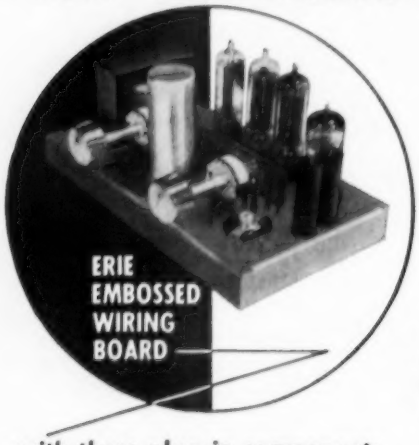


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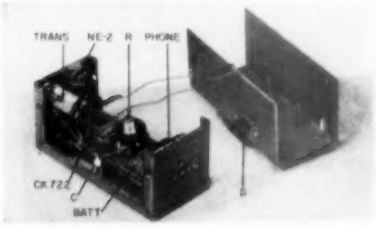
2 mils. Since so little current is drawn when the device is on, it can be left on continuously. The battery will last for something approaching shelf life.

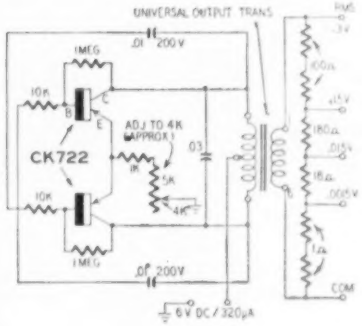
Ordinary construction techniques are used and the model was built into a Premier aluminum box, as shown in the photos. Most of the components listed have subminiature counterparts and the unit could conceivably be made much smaller. A CK722 or 2N107 works best in the circuit and most of the values given are not critical. Not all transformers work as well in this circuit so do some experimenting.




The circuit is triggered when held in an alternating magnetic field as produced by a soldering gun or power transformer. The pickup lead was held next to a telephone being dialed and the unit counted accurately the pulses produced by the dialing mechanism.—*Tony Karp*

## STABLE OSCILLATOR

This transistorized audio oscillator is my favorite because it produces a pure sine wave and does not develop spikes nor shift frequency when you touch it. It is stable and the components are not critical. The frequency is around 350 cycles when the transformer is a Stancor type A-3856 and its primary is tuned by a .03-$\mu$f capacitor. A small 6-volt battery, with positive terminal grounded, is used.




The secondary of the transformer, tapped at terminals 1 and 6, gave a 0.3-volt output with my setup. To obtain additional lower-voltage outputs, I put a voltage divider network across it, giving me three new outputs. These (0.15, .015 and .0015 volt) greatly increase the usefulness of this instrument.—*Clyde M. Stewart* END

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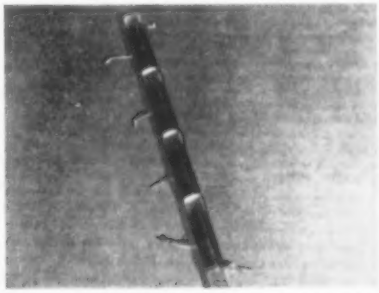
## BREAKLESS TAPPING

When winding small tapped coils, it is common practice to leave a loop to which connecting leads are twisted and soldered. This twisting and handling often causes a break after the coil has been in service for a while.

A better plan is to fasten short pieces of stiff wire to the form and use them as anchors and terminal points. Plastic rod is handy for coil forms and anchors are easy to install. Hold a hot soldering iron near one end of a piece of stiff wire held in a pair of pliers. Press the end of the wire against the plastic form until the heat softens it and the wire penetrates about halfway.



Let the plastic cool, then solder the loop or tap on the coil to the tie point. Coil taps anchored in this way are more sturdy and will hold up under strains that would break taps made by twisting or looping the wire with which the coil is wound.

Heat may cause a small mound in the plastic at the point where the anchor penetrates. This can be filed away to leave a smooth surface for the coil.—*Harry J. Miller*

## PROTECT TV–FM LEAD-INS

Salt in the atmosphere in coastal areas can quickly ruin the performance of TV and FM antenna lead-ins. To prevent this, merely enclose the line in the smallest available type of plastic hose. Be sure to seal the top of the hose at the point where the lead-in enters.—*A. von Zook*

(Plastic tubing and spaghetti are available in suitable lengths and diameters but lightweight plastic garden hose is easier to obtain and frequently less expensive.—*Editor*)

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1 – TV SYNCHROGUIDE TRANSFORMER #2008H$1
1 – TV SYNCHROLOC TRANSFORMER #2008W .$1
1 – TV RATIO DETECTOR TRANS. 4.5mc .....$1
1 – SET TV KNOBS standard size but decals .....$1
1 – LB SPOOL ROSIN CORE SOLDER 40/60 ....$1
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hearing aids and other apparatus using subminiature jacks for phones.

To make this adapter, obtain an extra tiny plug to mate with the jack on your equipment. You will also need two standard phone-tip jacks.

Strip the hardware off the tip jacks. Insert a phone tip into each jack (this holds the interior springs in place while bending the lugs) and bend the pair of lugs on each jack at right angles, as shown. Then enlarge the holes in the lugs just enough so you can slip them over the contacts on the tiny plugs and then solder the jacks to the plug as shown in Fig. 1.

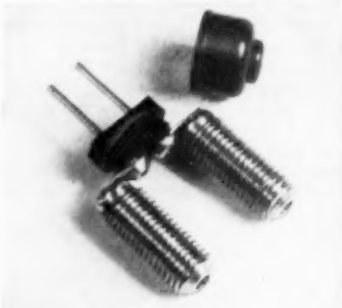

FIG. 1

Last, insert a piece of flat pencil eraser (cut to the required size) between the two tip jacks and wrap several turns of ¾-inch Mystik or equivalent tape tightly around the shanks of the jacks, as shown in Fig. 2. This completes the adapter.—*Art Trauffer*

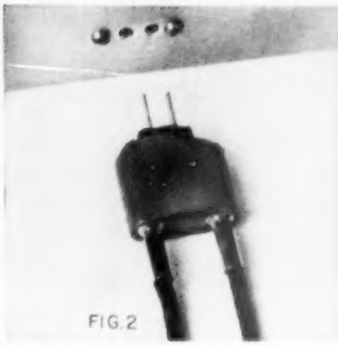

FIG. 2

## TUBE SOCKETS FOR KITS

Many electronic equipment kits are supplied with inexpensive wafer type tube sockets. However, you can add a lot to the quality of your unit by replacing these sockets with molded ones, which are much superior in looks and service. The change costs only a few cents and is a very small percentage of the price of most kits. The mounting dimensions of wafer sockets and molded types usually correspond so there should be no difficulty on that score. When buying the sockets, though, take along the wafer sockets for comparison.—*Charles Erwin Cohn*


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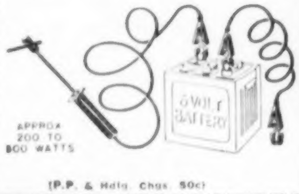


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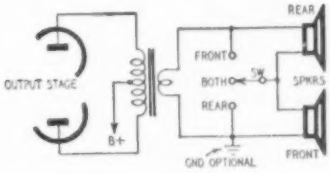
## AUTO SPEAKER SWITCHING

While installing a rear-seat speaker in a car, I found that I didn't have a three-way switch of the type usually used in these setups. I did, however, have a spdt switch with a center off position that is less expensive and works better in the circuit that I devised. See diagram.

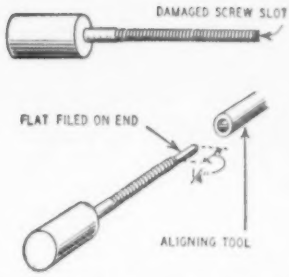



When the switch is in the center (off) position, the speakers are in series and the power divides between them. Throwing the switch in one direction shorts out the front speaker and full power is applied to the one in the rear. In the opposite direction, the rear speaker is shorted and the front speaker receives full power.—*Elgie P. Smith*

## DAMAGED TUNING SLUG

After butchering the end of the brass screw of a tuning slug in an FM tuner as at *a* in the illustration, I decided to reslot the screw. Needless to say the attempt failed.

*(Continued)*




The results of a second idea, however, proved very successful. First the dammaged end was filed smooth, then a flat surface was filed about ¼-inch from the end, making that part of the stud half-round. Now an alignment tool with a recessed blade could be slipped over the flat end (as at *b*) making it possible to turn the slug.

Note that the flat end of the stud will find a snug fit in the tool or that part of the recessed head between one side of the blade and the wall of the tool itself. With this arrangement it is virtually impossible for the alignment tool to slip off or damage the end of the slug.—*John F. Keidel*

## CORRECTION

Last month the item "Auto Speaker Switching" appeared with the figure from "Damaged Tuning Slug" which was not printed. Both items, with their proper diagrams, appear on this page.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| J. E. Murphy, Wesley Hotel, Washington, D.C. | 1st | 12 |
| Robert Todd, 216 West End, Cambridge, Md. | 1st | 13 |
| David Seigler, 216 Dowling, Walterboro, S. C. | 1st | 10 |
| W. Reynolds, 238½ Wash. Bl., Venice, Cal. | 1st | 12 |
| Richard Jones, Station KGHF, Pueblo, Colo. | 1st | 13 |
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# Business and People

**CBS-Hytron,** Danvers, Mass., will continue and expand its support of independent service technicians in its 1957 sales promotion program. National advertising will be combined with concentrated local promotion.

**Winegard Co.,** Burlington, Iowa, designed a complete antenna display for

qualified distributors and technicians. It includes a free Color'Ceptor antenna.

**Erie Resistor Corp.,** Erie, Pa., is sponsoring an educational training program for its technical and business employees, including basic and college training. Under the latter program the company will reimburse the tuition of employees who complete approved courses with a grade of C or better. The firm also released an employment recruiting brochure outlining the advantages of working for Erie.

**Radio Receptor Co.,** Brooklyn, N. Y., is preparing to produce a line of Petti-Sel selenium rectifiers developed by the Siemens Co. of West Germany.

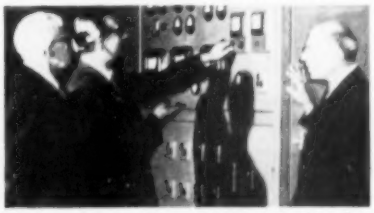

Photo shows Hugo Cohn, Radio Receptor, president, left, and Eric Waldkoetter, Siemens engineer, examining controls of production equipment while Julian Loebenstein, sales manager of the Radio Receptor Semiconductor Div., right, looks on.

**Hughes Aircraft Co.,** Culver City, Calif., has begun a work-study program for engineering undergraduates with full payment of college tuition and related expenses for students working part time in their chosen fields.

**Cornell-Dubilier Electric Co.,** South Plainfield, N. J., is underwriting an extended tour of its service engineering director, Bill Ashby, who is giving a


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series of color TV clinics in key cities throughout the U. S. Photo shows Ashby giving one of his "Chalk Talks," a highlight of the forums. The program is sponsored by local parts distributors.

**RETMA** general counsel, Glen McDaniel, explained to a Bronx (N. Y.) Grand Jury how tube and set manufacturers are attempting to dry up sources of tube counterfeiting by destroying worn-out tubes returned on warranties. He stated fraudulent practices are of two types: selling old tubes as new, and returning out-of-warranty tubes for warranty replacement.

**United Catalog Publishers,** Hempstead, N. Y., established Audiofile, a

new trade catalog service for hi-fi and sound distributors.

**Allied Radio Corp.,** Chicago, in cooperation with RCA, is conducting a series of seminars for technicians, based on the NBC TV color courses.

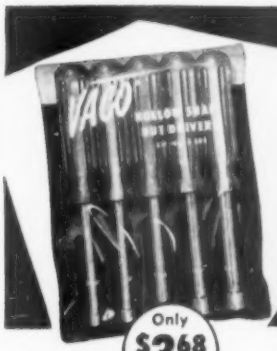
**Permo, Inc.,** Chicago, has redesigned the package for its Fidelitone phono-

graph needles. All needles are now packed in new transparent plastic boxes.

**Service Instruments Corp.,** Addison, Ill., established a new distribution system for its transistor setup charts and booklets. A service technician can now register for up to six mailings a year for $1. The money is put into a fund for this purpose.

**RETMA** reported the factory sale of 12,840,000 transistors last year compared with 3,646,802 in 1955.

**P. R. Mallory & Co.,** Indianapolis, Ind., unified its battery activities with the formation of the Mallory Battery Co., Cleveland, Ohio. Fielder Israel is president; Carl Rudiger, vice president; Walter Onorato, chairman of the management committee, and Ray Stone, comptroller.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**Gramer-Halldorson Transformer Corp.**, Chicago, reported that its suppliers approved its proposed reorganization plan which calls for full payment of obligations within a five-year period. Because of successful operation during the past year, the U. S. District Court approved the plan and permitted the approved and permitted operation free of further court supervision.

Stanley J. Koch was named general manager of the **Allen B. Du Mont** new unified Tube Div., Clifton, N. J. Prior to this he was director of the Tube Research Div. Alfred Y. Bentley continues as manager of the Cathode-Ray Tube Div., which will now be known as the Television Tube Div. Joseph P. Gordon, former assistant director of the Tube Research Div., now heads the division, which has been renamed the Industrial Tube Div.

A. K. Mallard (left) district manager of the Dallas territory for the **RCA** Tube Div., was promoted to manager–entertainment sales coordination. R. W. Frisbee (right), manager–sales coordination, was advanced to manager–industrial sales coordination. R. K. Joslin, distributor sales representative, succeeds Mallard as Dallas district manager.

Norm Edinger is now marketing service manager for **Triplett Electrical Instrument Co.**, Bluffton, Ohio. He has been with the company in various capacities for 15 years.

M. E. (Mel) Krumrey was promoted to manager of the Jobber Div. of **Quam-Nichols Co.**, Chicago. Before his promotion, he had been assistant distributor sales manager.

Tom Brown joined **Oxford Electric Corp.**, Chicago, as sales manager of the Distributor Div. for speakers and components. He comes to Oxford with wide experience in sales and sales promotion with such firms as Sears, Robuck; Ideal Carbide Die Co., Radio Cores, Inc. END

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# technical Literature

### COLOR TV CONVERGENCE CIRCUITRY

Application Note AN-168, *New Tubeless Convergence Circuit for RCA-21AXP22-A Color Kinescope*, describes this new circuit which uses a revised control system and permits complete dynamic-convergence connection.

*RCA, Commercial Engineering, Harrison, N.J.*

### TV TEST EQUIPMENT

A new folder of TV test equipment highlights the model 670 video scanner, the new Cardmatic punched-card automatic tube tester and test instruments in kit form.

*Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.*

### SELENIUM RECTIFIERS

*Selenium Rectifier Replacement Guide* prefixes its three sections (TV, radio and special-purpose replacements) with a description of fundamental circuits using selenium rectifiers, information on servicing and testing and some dimensional diagrams. Another extra feature is the cross-reference guides, for both selenium and packaged power rectifiers.

*Federal Telephone & Radio Co., Components Div., 100 Kingsland Rd., Clifton, N. J., $1.*

### PANEL METERS

Over 800 panel meters are encompassed in *Bulletin No. 2057*. Its 6 pages contain descriptions and specifications with photographs of meter styles and various types of available meter movements as well as dimensional drawings for meter mounting. Many typical meter scales are reproduced in actual sizes. Additional information is also provided about stock shunts and current transformers.

*Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.*

### NEW RETMA STANDARDS

Four new RETMA Standards have come out for the *Handbook*. *RS-159, Chassis Pickup of Vehicular Receivers*, from *Standards Proposal No. 499*, is a reaffirmation of *REC-111*. *RS-177, Vibrator Power Transformers*, from *Standards Proposal No. 509*, reaffirms *REC-119*. *RS-178, Solderability Test Standard*, from *Standards Proposal No. 503*, is new material as is *RS-179, Classification of Tube Testers*, from *Standards Proposal No. 506*.

*RETMA, Engineering Dept., 11 W. 42d St., New York 36, N. Y. RS-159, RS-178, RS-179, 25c; RS-177, 30c.*


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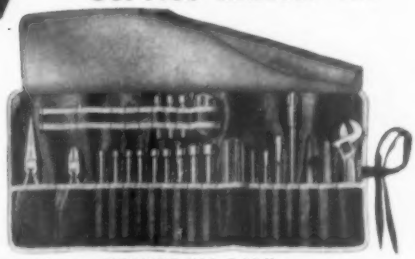

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TECHNICAL LITERATURE *(Continued)*

### RECORDING TAPE

The triumph of leprechaun F. R. O'Sheen over Oxenscheid, the oxide shedder; Wearhead, the head wearer; Frickenshaw, the frequency discriminator; Noysenhiss, the noise generator; Dropofsky, the dropout artist; Pringlethorpe, the print-through bug, and Brattleby, the embrittler, by means of a new process of tape manufacture is recorded in *The 7 Old-Fashioned Villains of Tape Recording*. This vest-pocket-size booklet also carries on its back cover a playing-time chart for all lengths of tape at the various speeds for both single- and dual-track recordings.

*F. R. O'Sheen, ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala.*

### TAPE RECORDERS

*Tape Recorders* is aimed at the professional broadcaster and recorder. Its variety of console, portable and rack-mounting units include a tape transport for the modernization of present equipment and a combination transport and amplifier for portable use. Some attention is given to binaural and stereophonic material.

*Magnecord, Inc., 1101 S. Kilbourn Ave., Chicago 24, Ill.*

### TIME CHART

Looking something like a mileage chart on the back of gasoline company road maps, the *Global Time-Conversion Simplifier* lists areas in this country and abroad by time zones. Then, in place of mileage figures, it lists the time of day and whether it is today, yesterday or tomorrow. Thus, the user can tell at a glance the time anywhere in the world for either standard or daylight time. Also shown is the method of figuring Greenwich Mean Time for every place in the world for every hour of the day and a 24 hour clock-system conversion (for the Armed Forces).

*Daiger Associates, Chamber of Commerce Bldg., Newark 2, N. J., $1.*

### DRY BATTERIES

*Section 4A* supplements this manufacturer's *Dry Battery Engineering Handbook*. On the subject of dry batteries for transistor and electronic applications, it consists of 11 engineering bulletins which include individual specification sheets on the batteries' physical dimensions and charts of their discharge characteristics and potentials.

*Ray-O-Vac Co., 212 E. Washington Ave., Madison 10, Wis.* END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.


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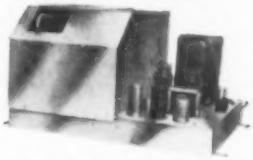

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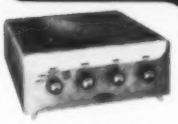

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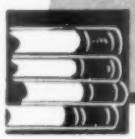

**MATHEMATICS AND COMPUTERS, by George R. Stibitz and Jules A. Larrivee. McGraw-Hill Book Co., Inc., New York, N.Y. 6 x 9 inches, 228 pages. $5.**

These authors believe that if (among other factors) you would rather get results experimentally than by numerical calculation, you have the making of a computist. The many persons in this group, as well as scientists, engineers and mathematicians will find much of interest here.

Basic mathematics and computers are discussed. It is explained how a computer is fed (with data), how it stores, transfers and delivers its information. An interesting chapter on "Monte Carlo" computation shows how games of chance obey laws of mathematics. For example, you can calculate "pi" by a game of tossing sticks. You can solve a linear equation with playing cards.—*IQ*

**ATOMIC ENERGY, by E. C. Roberson. Philosophical Library, New York, N.Y. 5 x 7¼ inches, 142 pages. $4.75.**

Much has been written about atomic energy, little has been understood. This book is written for nontechnical readers to provide a clear picture of what an atom is and how it behaves.

This subject concerns itself with the "inside" of an atom, just as electronics deals mainly with the "outside." The authors give interesting highlights on scientific discoveries about the inside of an atom, explaining such terms as "atomic pile," "fission," "bevatron," and others.

**RCA RECEIVING TUBE MANUAL, RC-18. Compiled and published by the Tube Division, Radio Corp. of America, Harrison, N.J. 5¼ x 8½ inches, 354 pages. 75 cents.**

The standard tube handbook for many technicians has a number of changes. It is larger than the former edition, even recent printings with 37-page recent-tube supplements. The basic theory and applications section in the front appears to have been completely rewritten, with one section one page shorter and another—Electron Tube Applications—five pages longer. The format is also different, with two columns instead of one on the page. Much of the old matter is, of course, carried over intact but new material, especially on TV circuitry, has been added.

The Tube Types section runs 223


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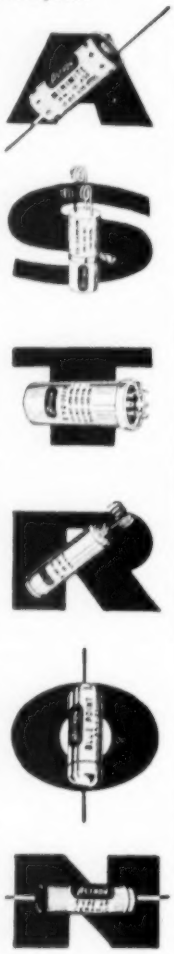

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**HIGH FIDELITY, by Charles Fowler. McGraw-Hill Book Co., Inc., New York, N.Y. 5½ x 8¼ inches, 310 pages. $4.95.**

Many "beginner" books expect too little or too much from their hi-fi audience. Some merely recommend certain types of equipment and leave little to the judgment of the reader. Others forget that they are appealing to beginners and don't explain in sufficient detail. Here is a book unusual for its clarity, yet complete in its coverage of topics. It tells about the principles of sound and the nature of hearing and describes each link in a hi-fi chain.

Extensive treatment is afforded speakers (and enclosures) as the weakest and perhaps least-understood components. Pickups, turntables, tuners and amplifiers are discussed in easy conversational style. Room acoustics and budgeting of equipment are among the subjects often omitted from such texts, but here they receive close attention. It all adds up to greater enjoyment of a popular hobby: listening to good music.—*IQ*

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**HANDBOOK OF BASIC CIRCUITS, by Matthew Mandl. Macmillan Co., 60 Fifth Ave., New York, N.Y. 6½ x 9½ inches, 365 pages. $7.50.**

The technician, instructor or engineer who even today occasionally refers to the ancient *Basic Radio* (Hoag) will find in this new work a wealth of circuitry that was unknown when the older book was published. Mandl has presented 136 circuits basic to TV transmission and reception, FM and AM. Each circuit is accompanied by a statement of its purpose and function and a description of its operation.

The chapter arrangement is original in a book of this type. Subjects are listed alphabetically, from Alternate Pulse Selector and Attenuators to Voltage Tripler and White Stretcher. This makes it very easy to find a desired circuit. No less than 20 brief appendices complete the book.—*FS*

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**ATOMS AND ENERGY, by Prof. H. S. W. Massey. Philosophical Library, Inc., New York, N.Y. 5½x8½, 174 pages. $4.75.**

The problem of nuclear reaction proved to be one of the most mystifying jig-saw puzzles of all time. For many years, the world's most brilliant scientists labored to find clues and fit them together. War emergency and the threat of war spurred research to reach the goal—atomic energy. In nontechnical, clear language, this book tells of scientific developments and how they increased our knowledge of the atom.

Starting with a discussion of atomic particles, the author explains chemical reactions and how they provide us with limited amounts of energy. Then we go on to Einstein's formula, the basic law for the release of tremendous energy from the nucleus itself. The book ends with thoughts on peacetime applications and the possibilities of future research.—*IQ*

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**ELECTRONIC METAL LOCATORS, by Harold S. Renne. Howard W. Sams & Co., Indianapolis 5, Ind. 117 pages. $2.50.**

A survey of the field of electronic prospecting and metal locating—with particular emphasis on material for the week-end prospector and treasure hunter. Complete construction details are given on several types of locators and circuit diagrams of a number of commercial instruments are shown. Also included are technical details on metal detectors for such industrial applications as tramp metal in chopped hay, logs and various food products.

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**REFERENCE DATA FOR RADIO ENGINEERS, 4th edition. International Telephone & Telegraph Co., 67 Broad St., New York 4, N.Y. 5½x8½ inches, 1121 pages. $6.**

This new edition covers the wide variety of topics that now comprise modern radio engineering. Here an immense store of data is arranged for easy location, to save time and energy.

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| Television News | 1931 |

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

**In May, 1923, *Science and Invention* (formerly *Electrical Experimenter*)**

The Future of Broadcasting, by H. Gernsback.
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Obtaining an Amateur Radio License.
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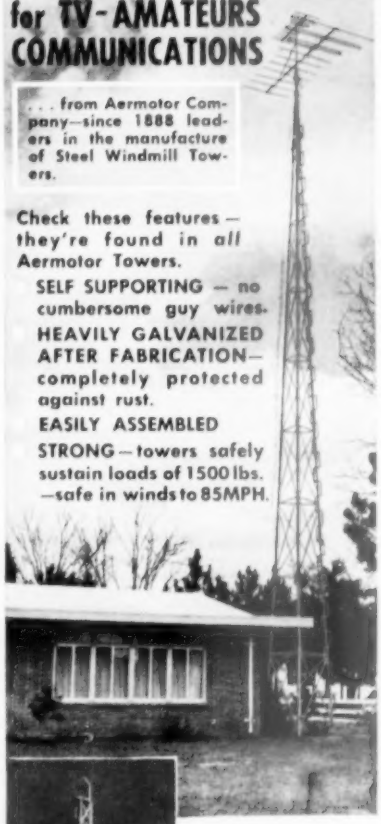

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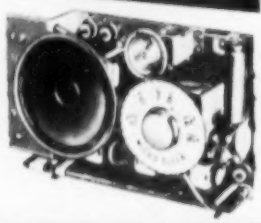

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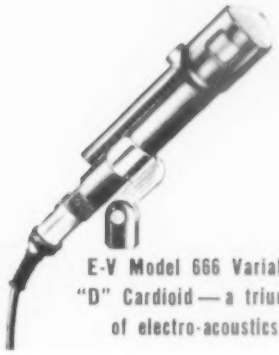

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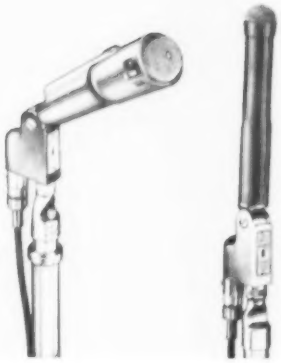

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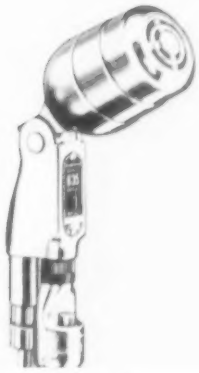

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